

Architectural Design of Jobs for People with Disabilities in Special Employment Workshops

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Abstract: Special employment centers and occupational centers have enormous relevance for the socio-labor integration of people with disabilities. The following work seeks to introduce the basic techniques of diligence, ergonomics and anthropometry into this type of center as an additional tool to promote the integration of the above mentioned through the architectural design, which helps to adapt the work to the abilities of persons with disabilities. With the procedure, the physical, psychological and sensory demands that are required for each activity were analyzed and, based on this, an analysis of the necessary adaptations for the performance of these people in their positions was carried out, proceeding to the architectural redesign of the same. Throughout the research, techniques and tools such as checklists, interviews, questionnaires and anthropometric design were used as a fundamental technique to develop the architectural design of the positions under study, taking into consideration the necessary adaptations to the person with a disability.

Key words: disability; adaptation of jobs; architectural design

1. Introduction

Although most people with disabilities who are of working age, willing and able to work, often face a number of serious barriers, including lack of employment, this contributes to the fact that people with disabilities tend to be more exposed to poverty, particularly in low and middle income countries [1].

A recent United Nations report on the rights of persons with disabilities emphasizes that the world's population is aging and the population over the age of 60 is growing at a rate of approximately 3% per year. The proportion of the population aged over 60 is expected to increase from 12% in 2015 to 21% in 2050, and it is emphasized that this growth can be seen in almost all countries in the world, which is not unique to high income countries [2].

Access to decent and high-quality employment is the most effective reason to break the vicious circle of marginalization, poverty and social exclusion. The design of disability benefits should facilitate the active participation of persons with disabilities in education, employment and society. This can be achieved by ensuring that cash and in-kind benefits cover disability related costs and promote the participation of these people in paid employment [3].

With the support of the International Labour Organization (ILO) as the specialized agency of the United Nations dealing with labour and industrial relations issues, a set of goals and policies has recently been developed in the 2030

agenda to achieve Sustainable Development Goals (SDGs), in which States have a responsibility not only to ensure effective access to social protection for persons with disabilities, but also to promote their economic autonomy and active participation in the labour market. According to the ILO, without effective protection and promotion measures for persons with disabilities, no country can achieve the SDGs [4].

One of the policies outlined by the ILO is the creation of occupational centers or special employment centers for people with disabilities as the central headquarters for the social and labor inclusion activities of people with disabilities. However, when it comes to putting into practice the integration of these people to these employment centers, the process of finding the right job for the right person is difficult, so that in many occasions employers reject the acceptance of employment of certain people who apparently are not able to occupy it, and yet more in-depth studies of the position and the capabilities of that individual, have shown that these people can perform certain jobs as efficiently as any person, and that sometimes only requires a prior adaptation of the position for its efficient performance. It is therefore essential to raise disability awareness and promote the development of reasonable accommodation in architectural designs to ensure inclusive workplaces that support diversity, disability or disabilities [5].

These reasonable facilities aim to eliminate or reduce these barriers, enable disabled persons to gain access to existing information and facilities, change equipment or work environments, adjust existing ways of doing things, or eliminate physical barriers in the workplace [6], thereby ensuring that all products, goods, environments, and services are accessible [7].

Globally, many scientific advances have been made in social work inclusion activities for persons with disabilities. In Cuba, in the field of work, in order to design appropriate career preparation and placement for persons with disabilities, an employment programme (PROEMDIS) has been implemented, which promotes the integration of persons with disabilities into social life.

Fernandez (2017) [8], ACN (2018) [9], Sanchez (2019) [10], IPS (2019) [11], Seijo (2018) [12], and Peres (2019) [13] said that the basic goal of these programs is to improve the employment opportunities of this group of people based on their skills, motivations, actual potential, and analysis of community needs, in their publications on the results of projects implemented for labor inclusion in different localities of the country.

Observations of these employment programmes and projects developed in Cuba indicate that their development is based on an analysis of the capabilities of these individuals, rather than considering the analysis of job needs as a key element in determining the necessary adjustments and adaptations to promote the employment of persons with disabilities. Therefore, only those applicants whose disability condition allows them to access a job and work environment that has already been designed are employed.

This is why the purpose of this work is to propose a process to promote job adaptation through the architectural design of the job, which takes into account the abilities of employees with disabilities in a particular job, thereby providing employment opportunities for employers of special work centers for the employment of persons with disabilities. And it is necessary to analyze the tools and technologies needed for each job, which can help improve working conditions, methods and design, and promote accessibility and labor inclusion for people with disabilities.

2. Materials and Methods

It is clear that vocational centres, especially special employment centres, have been of special significance in the field of social work integration for persons with disabilities in recent years. Regarding this issue, the procedures or methods used by authors such as Heron R (2015) [14] and Oiss (200) [15] to adjust and design buildings have been reviewed in the literature. The analysis of each method shows that they mostly evaluate each person's personal characteristics based on

their limitations, and determine the physical, sensory, and psychological needs of each job task based on the records of information generated by the analysis of these methods. Methods include market research, providing employers and workers with information about the need to adjust their jobs, and identifying job risks by analyzing work conditions.

Through an ergonomic analysis of existing spaces, furniture, equipment, tools, and other aspects, all of these comply with the comparison steps for the above elements, in order to subsequently adjust or design the workplace and environment. All of this is to provide employment for the disabled.

Among the methods studied, the most rigorous approach to job evaluation and its adaptation is the one proposed by Herranz (2009) [16]. However, all of these methods lack tools to identify and evaluate work, enabling readers to clarify how to identify work needs, and to redesign buildings based on the capabilities of people with strong functional diversity, because they only clarified how to redesign and adjust these positions from an ergonomic perspective. In response to this deficiency, a program has been developed to integrate job analysis tools to accommodate people with diverse functions.

In order to achieve the research objective, the following theoretical methods are used: from the general to the particular, analysis - synthesis, induction - deduction. Among other things, theoretical basis and procedures to be applied can be developed, as well as empirical methods, such as: expert selection method, teamwork techniques, Delphi method. In addition, a number of technologies and tools have been used, including questionnaire surveys, team work, document reviews, interviews, checklists, and anthropometric design, which allow theoretical design of work through the use of AutoCAD software, Microsoft Visio, and others.

3. Results

3.1 General considerations of disability

In recent years, people with disabilities have built a new model called Human Rights, which recognizes the diversity of people and considers the condition of disability as a matter that corresponds to everyone and not only to the person with a functional limitation, hence the term disability has evolved through a number of stages.

In its code of conduct on disability management in the Workplace, the International Labour Organization defines a person with disabilities as "any person whose chances of obtaining appropriate employment, returning to work, retaining employment, or promoting significantly decrease due to recognized physical, sensory, intellectual, or mental disabilities" [17].

Persons with disabilities refer to those who, when interacting with the environment (the human, natural, or man-made environment in which they develop economic, political, cultural, or social life), temporarily or permanently experience one or more physical or mental defects due to mental, intellectual, or sensory reasons. They encounter obstacles or limitations in fully and effectively participating in society on an equal basis with others.

This means that today's society has a responsibility to:

- To guarantee the self-determination and satisfaction of the person, through the quality of the services and support received.

- To consider disability as a cross-cutting issue in all areas - political, economic, social, among others - in which society is organized.

Eliminate the various barriers in the environment:

- Physical: transportation, equipment, buildings, outdoor spaces, technical aids and others.
- Social: awareness and attitude of society and family, assistance, support services, information, communication, public administration response, among others.

All these analyses indicate that in today's society, there is a trend towards adapting the environment and public spaces to the needs of persons with disabilities to avoid their social exclusion, as persons with disabilities are considered unable to interact with their own environment.

3.2 General aspects of job design and adaptation

Design is the end result of a process whose goal is to find an ideal solution to a particular problem regarding the different forms an object can take. Design involves a mental representation, followed by a graphic representation, showing how the planned work will be performed, considering not only aesthetic aspects but also functional and technical aspects.

3.3 Adjustments or adaptation of jobs

Before determining the meaning of job adaptation, it is necessary to define some related concepts:

- **Place of work:** These are all places where employed persons must stay or go to perform their work, such as offices, factories, plantations, construction sites, educational institutions and private residences [17].
- **Job position:** That part of the workplace where the worker performs his or her work, including the desk or work surface used, chair, material and other items [17].
- **Working capacity:** It refers to the skills and potential of the person to perform a certain task or labor. Work capacity is favored by training skills and learning appropriate techniques to improve performance [15].

It encompasses adjusting the workplace, including adjusting and modifying machinery and equipment, and/or modifying work content, working hours, work organization, and work environment to facilitate access to the workplace to promote employment for persons with disabilities [17].

The concept of job adaptation has two main components, namely, job needs analysis and the assessment of workers' functional abilities. The ultimate goal is to ensure that the requirements of the task do not exceed the individual's capabilities, that the position is available, and that it does not exacerbate existing defects and/or create new defects [18].

For the architectural design of workplaces suitable for workers with disabilities, it is necessary to consider certain ergonomic recommendations, such as the physical size of workers or the energy consumption and effort required for work activities, in order to be fast and effective for the company, but safe and comfortable for workers.

Therefore, it should not be forgotten that the principles and methods for adjusting the work performed by people with functional diversity are the same as traditional interventions (extreme individual design, adjustable interval design, and average level design) [19]. However, interventions in this area must be conducted to a greater extent in a personalized manner, and worker-task-job relationships must be analyzed. This means an analysis of job needs and an assessment of the functional abilities of the workers holding the position [20].

Some of the ergonomic considerations for job adjustment for people with disabilities, as outlined in the literatures of ILO (2020) [17], Solano (2006) [21], STPS (2008) [22], are shown below:

- Place the work area, controls, tools, and materials between the shoulder and waist for easy reach and manipulation.
- When determining the appropriate height of a work surface, it is important to consider: the elbow height of the person, the type of work to be performed, product dimensions, and the tools and equipment to be used.
- Where possible, choose tools that are light in weight and can be used interchangeably with both hands.
- To retrieve fallen objects or to facilitate reaching at short distances, electromechanical or mechanical reachers are available with gripping capabilities at the ends.
- In order to accommodate workers in wheelchairs, the height of the working surface must be between 75 and 80 cm. Wheelchairs are higher than traditional chairs, so they require a greater free height below the working surface, and do not interfere with handrails or, where appropriate, with joysticks.

- The free width under the working surface must be at least 80 cm and not interfere with the user's hands when operating the chair's push ring. Drawers or any other items that may cause obstacles in this regard should be avoided.
- The free depth below the working surface should be at least 75 cm to accommodate wheelchair users appropriately.
- Use tables with "L" type legs, instead of "H" or "T" type, as long as their stability is guaranteed when the user leans on the edge. Figure 1

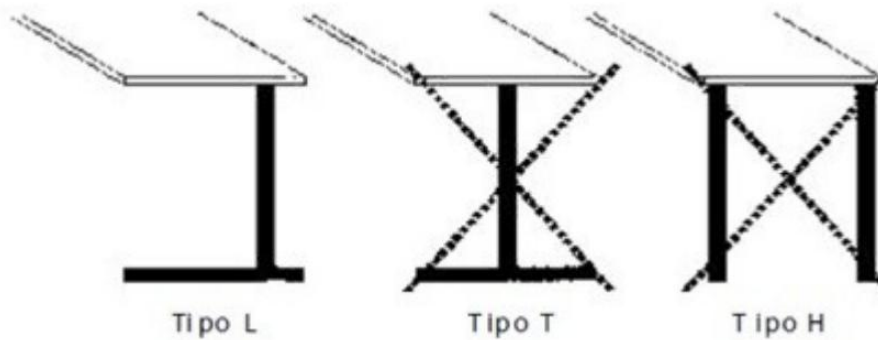


Figure 1. Design of a table for people in wheelchairs. STPS (2002) [22].

In any work area, it is important to consider the work area: normal, rare, and uncommon. Figure 2

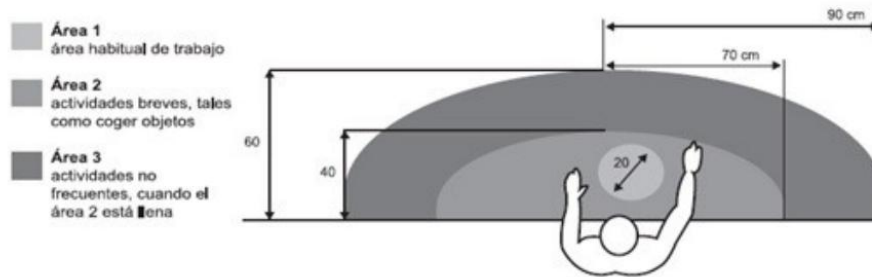


Figure 2. Maximum arm reach and its relationship to activity frequency. STPS (2002) [22].

The architectural design process for the workplace for the disabled in the special employment center is shown in Figure 3.

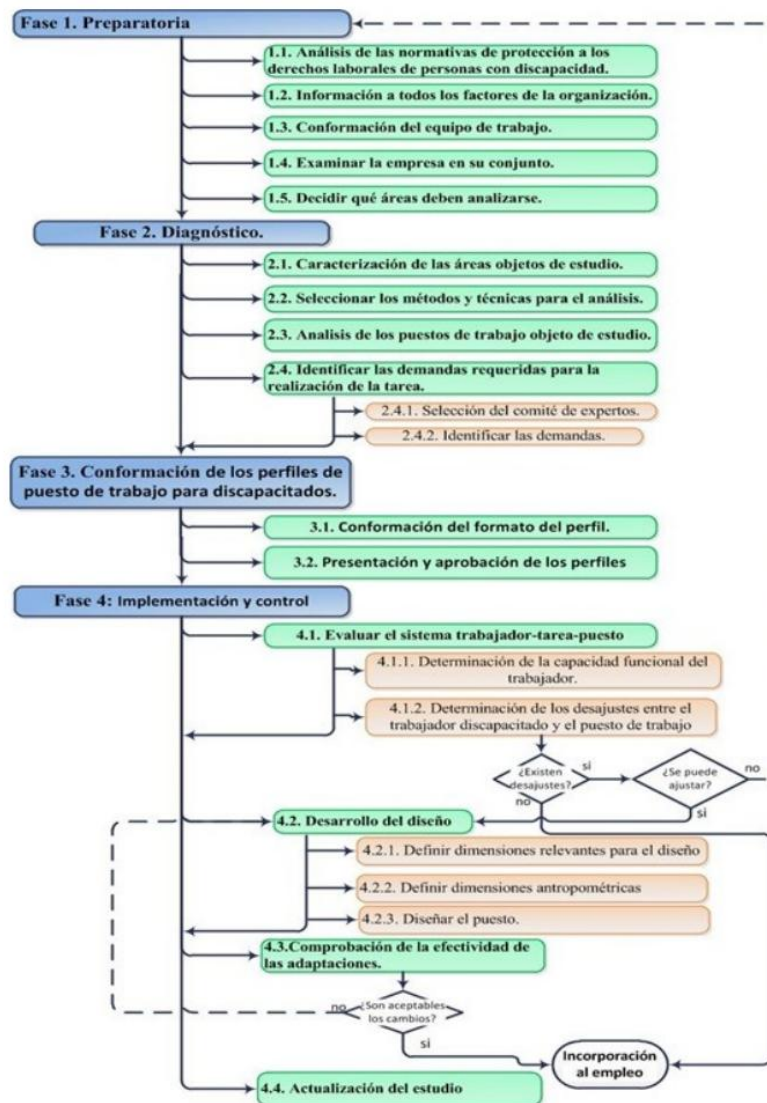


Figure 3. Procedure for the architectural design of workstations for people with disabilities in Special Employment Centers. Author's own elaboration.

The first stage is the preparatory stage, in which all regulations on the protection of the labour rights of persons with disabilities are reviewed in order to provide readers with all specific information related to the employment of persons with disabilities, as reading and consulting this compendium of standards will help to understand their rights related to promoting and defending their employment inclusion. At this stage, information is also provided to all actors involved in the process of inclusion and adjustment in this work. This task is crucial for removing psychological barriers that may hinder the development of this process.

The second stage describes the area and work of the study. To this end, interviews were conducted and observation was used as a technique to verify the information collected from interviewees. As observation alone is not sufficient, it is recommended to rely on other sources of information such as questionnaires and checklists filled out by employers and workers. Another action to be carried out at this stage is to use the techniques and tools proposed by Maynard (2006) [23]

and Castellano (2011) [24] to analyze the methods and tasks of the work, in order to search for and describe the following information based on the statements of Sebastian (2010) [25], Heron R (2015) [14], Santiago (2018) [26], and Remesar (2017) [27]:

- The specific tasks that are carried out in that job;
- Which tasks are essential and which are incidental to the job;
- How exactly the tasks are performed;
- How much time is spent on each task;
- Why the tasks are important;
- The materials and equipment to be used;
- Procedures to be followed;
- Working conditions;
- The working environment;
- The essential demands required for each task.

In order to determine the physical, sensory and cognitive requirements for the positions under study, an expert committee was established, consisting of occupational health and safety experts, health experts responsible for the medical assessment of persons with disabilities and specialists in this field.

The group of experts is presented with a list of demands previously identified by the working group and the Delphi method is applied to reduce this list.

With the information collected in the previous phases, we proceed to phase 3 for the description of the jobs for the disabled, through the conformation of the job profile. The profile models proposed by STPS (2002) [22], SCE (2016) [28] can be used.

After collecting information about the job, the fourth stage was carried out to consider the suitability of the workers for the existing work system based on their functional capacity and to compare it with the job requirements based on the worker's disability certificate issued by the medical board and using the use of CIF (2001) [29].

From this comparison, three situations can be obtained:

- a. Incorporation into employment is possible without adaptations.
- b. It is possible to enter employment with adaptations.
- c. Incorporation into employment is not possible.

In the first case, this task is suitable for the work ability of the disabled, with no risks or risks being controlled. In the second case, the functional abilities of the disabled worker require certain adjustments and work adaptation measures to join, so the position must be redesigned according to the following instructions.

The steps to develop an anthropometric design are:

- Define dimensions relevant to the design: in this phase the technical characteristics of the working medium to be designed are determined.

- Identify the anthropometric human dimensions that correspond to the dimensions relevant to the design.

In order to design each relevant dimension of the media, it is necessary to analyze which dimensions or anthropometric dimensions are necessary. To this end, it is necessary to first analyze the existence of anthropological information about the population being studied, which may be in two situations:

- a) There is anthropometric information on the population under study.

In this case, we proceed to apply the equation $X_p = \pm \beta S$ proposed by [19].

b) There is no anthropometric information of the population under study.

In this case, the worker occupying the position must be measured to determine their anthropometric dimensions. Once these two characteristics are identified, you can use AutoCAD software to develop the architectural design for the position.

4. Discussion

Applying the program in a special workshop with handicrafts made by disabled people as the basic activity can identify three positions that need to be adjusted for disabled people working in the workshop. A detailed description of one is as follows:

Separator: this position involves an employee who is responsible for selecting and cleaning the henequen strands from 100 kg bales of fiber. The worker, with the use of his hands, forms strands of yarn by tying knots in each strand until each strand is 10 m long, using a pair of scissors to cut the strands when they exceed the length. The formed strands are rolled up in the forearm or in a cone to form the rolls of strands that will pass to the next work station.

A 38 year old man who suffered from paraplegia due to spinal cord injury and was unable to walk worked in this position, so he sat in a manual wheelchair as a yarn fiber separator and cleaner. This man has complete lower limb mobility limitations. His upper limbs have all functions intact and he can maintain balance in the sitting position. It is difficult for him to reach objects that are higher than 160 cm and lower than 30 cm, as well as to reach objects whose frontal distance is greater than 75 cm deep. It requires accessible physical spaces that guarantee independent mobility within the workstation and workplace in general. The mismatches identified between the disabled worker and the workplace are:

- The movement of the hand must be maintained at a minimum level, as the worker must throw the prepared yarn roll into the finished product area. To perform this action, he must move his fingers, wrists, forearms, arms, and shoulders to maintain the movement at the last level.

- Regarding the distribution of tools and materials in the workplace, it can be seen from the schematic diagram of the workplace that there is no warehouse for storing raw materials, and raw materials are placed on the floor. This sometimes leads to workers having to rotate their wheelchairs and tilt their torso forward for a distance of 30 to 35 cm. When the raw materials are completed, this distance will become smaller. He will handle it. There is also no place for workers to place scissors and semi-finished products in the work area, so scissors and semi-finished products must be used as legs

- Principle 11 was violated because the position does not have the conditions to lower the raw material due to gravity, and the operator must tilt his torso to grasp it.

The development of adjustment.

Separator

This post requires a table with a deposit where yarn bales to be cleaned by workers are placed. The design of the table must be able to support a yarn bale with a size of $100 \times 90 \times 100$ cm and a weight of 100 kg. The worker must reach the dirty strands with an electromechanical arrival device, which places them close to the maximum front of the arm in order to collect the strands one by one. The strands will be cleaned and stored in a box located on either side, while on the other side is a warehouse where the waste generated by cleaning the strands is dumped.

Two holes will be designed on each side of the table. Once the worker has cleaned up, the yarn spools formed by the worker will fall off by gravity through a channel.

The purpose of this design is to improve methods and working conditions, avoid tilting the torso, accumulating waste on the legs, and throwing the finished product into a storage tank by hand. Table 1 summarizes the design development measures.

The measurements were taken in some cases from direct measurements to the actual worker in the position, others from the recommendations proposed by STPS (2002) [22] on the design of ergonomic workspaces for handicapped people from the analysis of standard wheelchair measurements [30].

Table 1. Design features of separator workstation

Dimensiones relevantes del puesto de trabajo	Características antropométricas.	Mediciones
Altura de la mesa	Altura de la silla de ruedas del piso al brazo.	75 cm
Profundidad de la mesa	Alcance máximo del brazo	75 cm
Ancho de la mesa	Alcance lateral del brazo	2*76 cm
Altura del depósito de Materia Prima	Altura de las pacas	100 cm
Ancho del depósito de MP	Ancho de la paca	90 cm
Largo del depósito de Materia Prima	Largo de la paca	100 cm
Ubicación de las cajas auxiliares	Ancho de codo sentado + Alcance mínimo de brazo	
Superficie libre debajo de la mesa entre las canales	Ancho de la silla de ruedas	80 cm
Diámetro del agujero de la mesa	Diámetro de la bola de hilo	35 cm

The design of the workstation is shown in Figure 4.

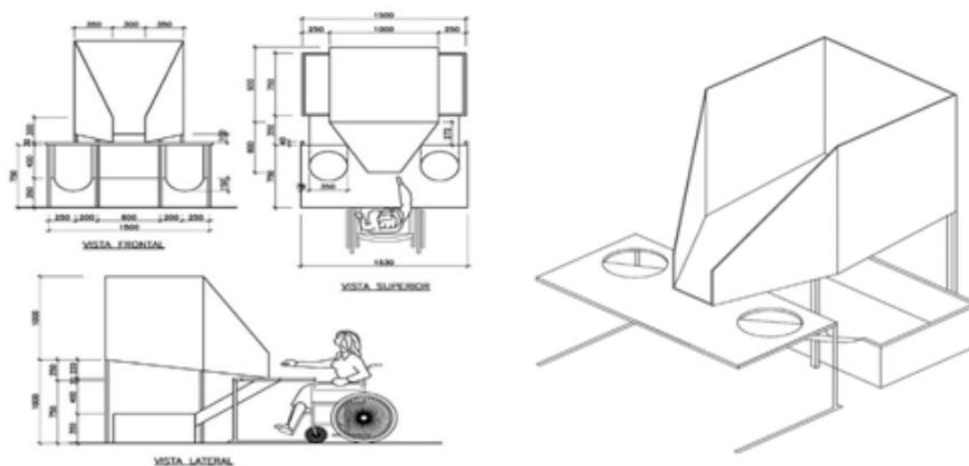


Figure 4. Proposed design of the separator workstation. Author's own elaboration.

5. Conclusion

Research on the conceptual elements of disability and work adaptation has shown that in terms of employment for persons with disabilities, it is necessary to describe the specificity and needs of the position in order to adapt to the abilities of persons with functional diversity. However, it must be emphasized that due to the existence of an unlimited number of disabilities, it is impossible to determine the anthropometric information needed to adapt to work. This can be said that every work adaptation situation of a disabled person is unique and should not be generalized.

The proposed procedure helps to adjust jobs and makes it easier for employers to include persons with disabilities in the employment of special employment centres, as it provides them with the tools and steps needed to adjust or redesign their jobs based on their functional abilities. The procedure was validated at a special workshop, but due to the time required to evaluate the results, it is not possible to fully implement it.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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