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MANUSCRIPT FORMAT

SPECIALIZED ELEVATORS FOR PEOPLE WITH DISABILITIES

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Abstract: Access to higher floors of buildings for people with disabilities is a problem that every society faces and needs special attention. Buildings with staircases represent an architectural barrier and prevent access to the facility for persons with disabilities. In this paper, elevator solutions for people with disabilities will be shown.

Key words: elevators, people with disabilities, special devices

1. INTRODUCTION

Most buildings and other structures have a staircase that represents an architectural barrier and completely denies access to the facility for people with disabilities, especially those who are wheelchair users.

This problem should be approached in such a way as to enable the person using the wheelchair to be able to move independently with the help of the technical solution offered. Before deciding which solution is optimal in a particular case, it is necessary to analyze the following [2]:

- whether the disabled person will sit, stand or be in a wheelchair during transportation,
- whether the standard seat will fit in size and the user will need a special child seat,
- if a person with a disability can get worse over time, a solution should be chosen that will be functional even after the eventual deterioration,
- it is necessary to know whether the device will be handled by a disabled person, trained person or both,
- it is necessary to define whether or not movement controls or controls are accessible to the user,
- when installing into an existing building, it is necessary to make an analysis of whether it is necessary to adjust the interior, ie whether a new arrangement of doors, radiators is needed.

It is necessary to ensure that, after the installation of the device, a regular staircase can be used.

2. OVERVIEW AND ANALYSIS OF EXISTING SOLUTIONS

2.1. Vertical elevators for people with disabilities

Vertical elevators with platforms used for wheelchairs provide the greatest independence in movement. However, these lifts take up more space and require more work to be done during installation.

Vertical elevators without shafts are mainly applied in homes, fig. 1a. Transport of people is accomplished with the help of a rail fixed to the wall. The door closing on the elevator is checked electronically. If the door is open, the

elevator will stop automatically and will not start until the door is closed. The ceiling cover opens and closes automatically when the elevator moves.

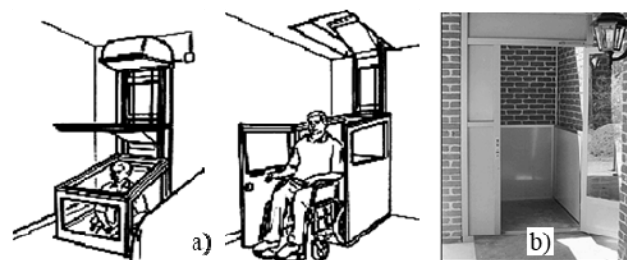


Fig.1. Vertical elevators without shafts (a) and with shafts (b)

Vertical shaft elevators are widely used: in households, residential buildings, as well as office buildings, fig. 1b. They must be closed and require larger work during assembly.

For vertical elevators of this type, the shaft is made of glass or metal, and their advantage is that they provide the ability to transport more than one person. They must have an additional ramp to assist the exit and entry into the elevator, whereby the user himself raises and lowers the ramp [3].

2.2. Staircase elevators

Staircase elevators are mounted on a rail that accompanies the staircase, and can be installed on either side of the staircase. They can have straight and curved tracks. Staircase elevators can be installed and removed very quickly.

There are seated, standing, staircase elevators with reclining and staircase elevators with platforms.

The sitting staircase elevator is equipped with a swivel chair and handrails that make it easier to sit and get up from the chair, fig. 2. The swivel seat is electrically or manually operated. The control can be done by the user himself, but with the help of adequate control equipment, a trained person can assist in transportation [3].

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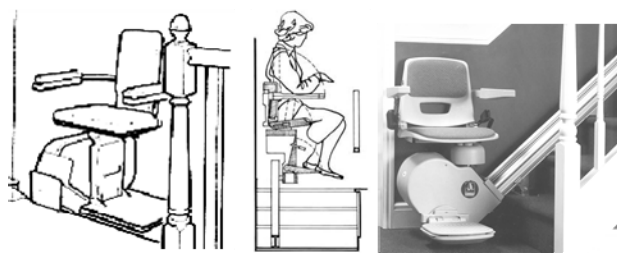


Fig. 2. Sitting staircase elevators

Persons who use crutches can use the elevator where they have space to accommodate aids when walking. The chair is positioned eccentrically to get as close as possible to the edge of the upper staircase when rotated about an axis, making it much easier to get up and sit.

Standing staircase elevators are used for persons who can stand on the elevator during transport or for persons who cannot stretch their leg (rigid leg), fig. 3a. These elevators take up less space in the staircase compared to the sitting one.

These elevators typically have 1 or 2 handrails on which a person can hold, which increases safety when transporting. There is an option of sitting elevators where the chair folds down.

Staircase elevators with leaning are very similar to standing ones, with the exception that they provide additional support below thighs, fig. 3b. And these lifts have handrails.



Fig. 3. Standing staircase elevators (a) and staircase elevators with leaning (b)

Staircase elevators with a platform allow people with disabilities, along with a wheelchair, to be transported from floor to floor. Although the platform can be folded against a wall, it takes up a lot of space. Platform elevators are done on a straight and curved staircase. The platform elevator on a straight staircase can be used for all types of stairways and slope angles, fig. 4a.

The features of this elevator are easy to use, easy control (one touch), maximum user safety. There is a wide range of places for the installation of such a platform lift, namely schools, office buildings, churches, theaters, residential quarters, stadiums, etc.

There are two stops: on the ground floor and at the top of the stairs. No between stopping is foreseen.

In fig. 4b, the layout of the platform elevator for the curved staircase can be seen. The elevator is used for stairs that have a curved route. The basic difference from

a straight staircase elevator is in the concept of the drive. It is applicable for lifting heights up to two floors [3].

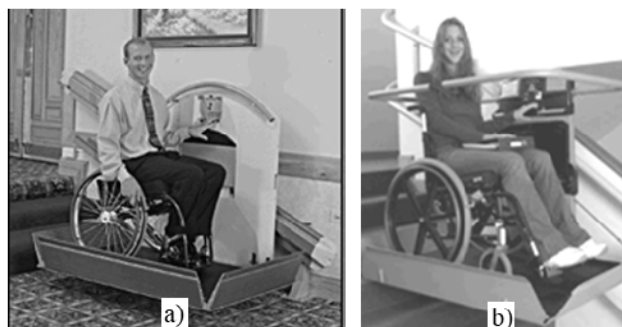


Fig. 4. Platform elevator on a straight route staircase (a) and on a curved route staircase (b)

2.3. Stair climbers

All of the previous solutions, however simple they may seem, require careful analysis and consideration of the location and method of installation, to ensure the safety of the persons using them. The shown devices solve problems on a single staircase, so in buildings with multiple staircases more elevators need to be installed. Because of this, stair climbers have been created that are simple and much cheaper than elevators. These are mobile devices adaptable to all types of staircases with different inclination.



Fig. 5. Universal stair climber (a) and standard stair climber (b)

Mostly these devices are used in residential buildings, where there is less need for the transportation of people with disabilities, and less can be found in public buildings. All this comes from the relatively long preparation of the person being transported by the escort. In the end, there is a fundamental difference between elevators and stair climbers, which is a companion. A stair climber is a device that grasps a wheelchair and moves using tracks over stairs.

The universal stair climber seen in fig. 5a provides accessibility to all places where stairs appear as an obstacle. The uniquely designed platform adapts to all types of wheelchairs, including self-propelled, children's and sports. Although robust, it is easy to operate and offers a high level of security.

The standard stair climber shown in fig. 5b is safe, reliable and easy to use. It is designed to snap under standard wheelchairs. It also allows weaker people to push the device without problems up and down the stairs at a maximum angle of 35° [3].

2.4. Evacuation chair

A chair of this type is an evacuation device used to transport people with disabilities down the stairs during an emergency. It has a patented speed controller and braking system, so that a person with less physical strength is able to easily evacuate a larger (heavier) person as shown in fig.6 [5].



Fig.6. Evacuation chair

3. COMMON PROBLEMS WITH OPERATIONS OF SPECIALIZED ELEVATORS FOR PEOPLE WITH DISABILITIES

3.1. Door opening problems

One of the biggest problem that occurs when installing special elevators for people with disabilities is the problem of doors. The point is that the rail, ie the elevator guide must be installed along the entire route so that in some parts it may pass by the door, which would interfere with entry and exit of the room. This problem is solved by sectioning the rail at the door area so that the part of the rail can be lifted. This lifting and lowering is accomplished manually or by remote control [4].

3.2. Controls and power supply

Controls and managing devices for elevators for people with disabilities can be standard, mounted at the end of handrails, or other devices such as a joystick may be used, fig 7. These lifts can be operated by the user from his / her position, or a trained person may be in charge of the management process, who will do this with remote controls.

Most elevators are supplied from the grid, with straight-line elevators having battery power in the event of a power failure. Elevators with curved routes have the ability to be powered by rechargeable batteries, which are charged at the beginning and end of the staircase.



Fig.7. Control options

Staircase elevators can be installed outside with controls at the bottom and top of the staircase, in stainless steel cabinets that are kept locked up [5].

4. PROBLEMS WITH STAIRS AND STAIRCASES IN FACILITIES IN THE CITY OF NOVI SAD

On the basis of the previously processed technical solutions, an analysis was made of the institutions in Novi Sad from the aspect of accessibility to people in wheelchairs, as well as technical solutions within buildings.

The simplest solution is a wheelchair ramp. According to new standards, the permitted angle of inclination of the wheelchair ramp is 6%. [1]

Fig. 8 shows the approach to the Serbian National Theater in Novi Sad where the situation is specific as it consists of multiple stair partitions. Therefore, it is impossible to think of a single stair elevator, so the possible solution is a mobile stair climber.



Fig.8. Ramp of big length at the Serbian National Theater in Novi Sad and the usage of a stair climber

The problem at the Faculty of Technical Sciences in Novi Sad is not reflected in the entrance to the building, but there is a problem in the Faculty corridor as well as in the teaching block.

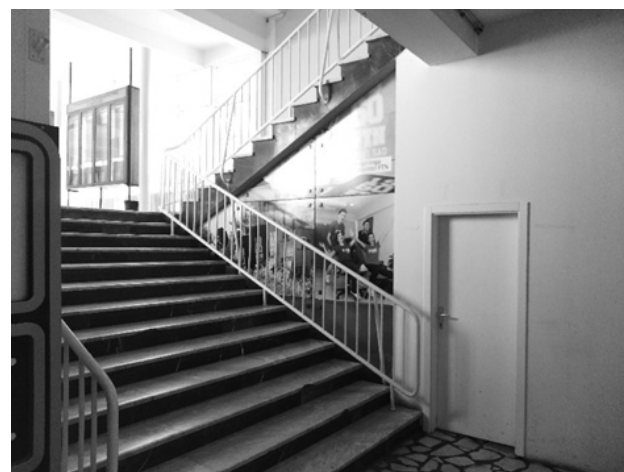


Fig.9. Wide staircase in the Faculty of Technical Sciences corridor

Fig. 9 shows very wide staircase located in the corridor, where the platform would not cause any particular problems to other staircase users. Considering the staircase extension, it is possible to install a curved route staircase elevator at this location, fig.10.

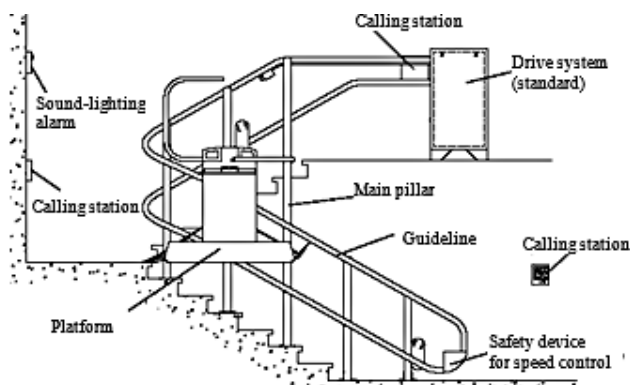


Fig.10. Possible solution with the curved route staircase elevator

On the other hand, due to sufficient space available, ramps were installed at the entrance to the Faculty of Technical Sciences main building, fig. 11, as well as at the entrance to the Mechanical Engineering Institute building, fig. 12.



Fig.11. Ramp at the entrance to the Faculty of Technical Sciences main building



Fig.12. Ramp at the entrance to the Mechanical Engineering Institute building

5. CONCLUSION

The paper deals with several devices that are used to transport people with disabilities across stairs and staircases. Classic vertical elevators can also be installed for big height differences, but require larger construction work, especially if they are subsequently installed in the facility.

The disadvantage is the price. Staircase elevators are less expensive and require less space during installation. They can be sitting, standing or with a platform. Even cheaper devices for the transportation of people with disabilities are stair climbers that can be adapted for all types of stairs and staircases. The disadvantage of these devices is that people with disabilities are not independent, but need a companion. It should be noted that all these devices can be used outside when approaching the building, but the most economical solution, unless it is a large height difference, is a ramp.

Designing elevators is a very demanding and responsible job. Each elevator is designed according to general principles and requirements. Very often, small changes can significantly advance common practice. If the issues of persons with disabilities are taken into account in the planning phase, and if they are involved in the process of defining a particular program, the costs of possible adaptation would be avoided. At the same time, this provides conditions for the implementation of the social model of disability.

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