

Universal design in supporting people with special needs in using of their own passenger cars

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Abstract. The paper describes the basic concepts of universal design, inclusive design, accessibility, and people with special needs. Selected legal regulation related to the universal design are provided as well. Practical application of universal design in individual transportation are presented.

1. Introduction

Universal design is one of the design concepts that considers the needs of all people. This concept refers to a user-centric strategy to meet the needs of all people, regardless of age, height, and ability to have equal access, while aiming for slight or no additional cost [1]. Universal design according to a different definition is the design of environments and products that are possible to use for all people as much as possible, without the need for adaptation or specialized design [2].

Inclusive design is a design process for a specific person or use case and extending it to others. Inclusive design can be applied to any product or service and does not intentionally group people together. Instead, inclusive design considers the full range of diversity in terms of culture, skills, gender, age, language, and other forms of interpersonal differences. It also considers how to serve the different people who will use the product or service.

Universal design and accessibility are usually combined due to focusing on making products available to a wider group of people. However, accessibility is more limited due to its focus on specific facilities for disabled people. Accessibility is one of the elements of universal design, but it does not consider many areas. Designs created as part of the universal design process are accessible since the needs of people with different abilities are considered part of the design process. The available designs are not necessarily universal or inclusive [3].

A person with special needs is a person who, due to his external or internal characteristics, or due to the circumstances in which he or she finds himself, must take additional actions or take additional measures to overcome a barrier to participate in various spheres of life on an equal basis with other people [4].

2. Universal design in legal regulations

The concept of universal design, as well as the necessity of its introduction and application have been conditioned by various national and international laws and regulations, some of which are listed below:

- Act of July 19, 2019 on Providing Accessibility to People with Special Needs (Journal of Laws of 2019, item 1696) [4].

- Constitution of the Republic of Poland of April 2, 1997 (Journal of Laws of 1997, No. 78, item 483, as amended) [5].
- Charter of the Rights of Persons with Disabilities of August 1, 1997 [5].
- Convention on the Rights of Persons with Disabilities, New York, 2006.12.13 [6].
- Charter of Fundamental Rights of the European Union [7].
- Union of Equality: Strategy for the Rights of Persons with Disabilities 2021–2030 [8].

Conclusions resulting from the content of some of the above-mentioned and other unlisted documents in the field of mobility and individual transport of people with special needs allow to state that the possibility of participation of these people in social life will increase due to universal design of products.

More and more often, universal design is considered only in the context of the first above-mentioned definition. This is due to, inter alia, the Convention on the Rights of Persons with Disabilities which compares it with the definition of a person with a disability. In general perception, it is simplified to simple slogans: "design for all", "design for people with disabilities".

In engineering practice, it is recommended to use the following seven principles of universal design:

1. Equitable use.
2. Flexibility in use.
3. Simple and intuitive.
4. Perceptible information.
5. Tolerance for error.
6. Low physical effort.
7. Size and space for approach and use.

The principles seem complicated but can be illustrated with a simple architectural example corresponding to the 1st principle – equitable use (Figure 1):



Figure 1. Illustrating the 1st principle of universal design [9]

- The ramp can be used by everyone – parents with prams, wheelchair users or people carrying heavy loads, but at high levels its construction is no longer justified.
- The stairs and the elevator are equivalent solutions, enabling users to choose the optimal option for them and are effective for larger differences in levels.
- The lifts are not a universal solution – technical limitations restrict the group of users (usually only to wheelchair users), are difficult to use (low speed, the need to hold the button constantly while driving) and pay excessive attention to a person with a disability.

The literature describes several tools used as part of universal design, in various areas (e.g. related to residential buildings, streets, pavements, railway stations, places for walking or schools, etc.), illustrated with specific examples.

Universal design in practice expands markets and increases consumer satisfaction since it considers all kinds of differences and preferences [10].

4. Universal design in individual transportation

The most comfortable journey is by individual means of transport, and sometimes even the only one available. Therefore, it is important to enable people with special needs to use such type of transportation. If the vehicle used in individual transport is to be used by People with Special Needs, it is sometimes necessary to very costly adapt such vehicles to their needs [11].

The means of transport used in individual transportation of people with special needs can be divided into:

- vehicles adapted to be driven by a specified disabled driver or to carry a specified disabled passenger (usually used as private vehicles);
- vehicles adapted to the transport of various disabled people, especially wheelchair users (most often used by various types of institutions).

Most mass-produced passenger cars can be equipped with individual device intended for a specific physically disabled person. Four ergonomic problem areas can be distinguished with such adaptation [11]:

- 1) Getting in or out.
- 2) Driving.
- 3) Loading and unloading a wheelchair.
- 4) Maintenance activities.

In the case of a disabled driver, the first, the second or the third of these four areas are usually adapted to the disability-related needs, whereas the fourth area does not usually require any device. The third area – loading and unloading a wheelchair – is depicted in Figure 2. The wheelchair can be loaded as follows [12]:

- by oneself without assistive devices – the wheelchair is placed in the front passenger's seat or in the rear seat,
- by oneself with the use of a foldable driveway or elevator,
- by oneself with the use of a crane,
- by an accompanying person.



Figure 2. Wheelchair loading device [13]

A popular solution supporting the loading of a wheelchair is a system that allows loading a wheelchair unfolded or narrow width folded.

5. Universal design in supporting people with special needs in using of their own passenger cars

People with special needs determine a diverse group in terms of their features, requirements, and needs. During designing in a universal manner, it is recommended to consider the widest possible catalogue of needs, features and requirements of people who will use a given product and/or services.

Accessibility is more limited due to its focus on specific facilities for disabled people as mentioned earlier. The effect of inclusive design of the driver to use his own car by equipping it with e.g. a driver's seat (Figure 3) is an example of the selective availability of people with special needs.



Figure 3. A rotatable seat facilitating boarding for disabled people [14]

The possibility of self-boarding the vehicle depends on the type and scope of the disability. This ability is crucial for wheelchair users, i.e. for people with mobility disabilities. The following situations are possible in this context [12]:

- there is no need to use additional devices,
- additional holders are required,
- changes in the driver's or passenger's seat are required: additional elements connecting the seat of the trolley and the car, increased range of seat adjustment, a rotatable and partially retractable seat,
- a crane for a user who does not move onto a seat by himself or a ramp for a person driving (or transporting) in a wheelchair is required.

Getting in or out by oneself in combination with the self-loading and self-unloading of the wheelchair may cause many problems such as: increased requirements on wheelchair, a risk of damaging the vehicle during loading, an insufficiency of interior space, an excessive biomechanical load on the human musculoskeletal system, or a duration of the entire procedure [12].

The extent of disability is here a key determinant of accessibility realized by inclusive design focusing on creating a product used by all.

6. Conclusions

The extent of disability is a key determinant of accessibility realized by inclusive design focusing on creating a product used by all. Such aim can be achieved by the interaction of universal design in this area, which can be expanded and thus cheaper and more accessible.

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