A Solution of Wheelchair Accessibility in Existing Building – Apartment Building in Kraslice

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Abstract. The aim of this paper is to provide information about solution possibilities in the design of wheelchair accessibility in the existing apartment building. Given the growing population of the elderly, and the efforts to integrate people with health disabilities into society, greater emphasis is placed on ensuring a barrier-free environment in public places, in public infrastructure and at public buildings. Infrastructure, premises, and buildings without barrier-free modifications make it difficult to use and move around or through it. The government is actively trying to resolve these things by creating new texts of building laws, decrees and building standards and by tightening the rules for issuing building permits for new buildings. At the same time, the building authorities have the power to order the owner of the building or the place its construction modification to ensure the barrier-free environment. An example will be given to the existing apartment building in Kraslice city in the Czech Republic, where the building authority ordered an owner of the building to secure construction modifications for the barrier-less use of the building. The solution of barrier-less use of the apartment building for persons with reduced mobility is based on the building layout, possibilities and needs of persons in a wheelchair and persons with a baby stroller, as well as from the building layout and possibilities of persons using crutches, sticks, walkers or other equipment for walking, pregnant women and persons accompanying children under three years of age. The design of the wheelchair accessibility of the apartment building is based on the applicable building law, relevant decrees and building standards, as well as on the implementation possibilities, taking into account aspects such as the existing layout and its possibilities, structure system design, technical equipment, possibilities of surrounding area and investor's financial options. The result is the realization of barrier-free entrance into the apartment building based on the most feasible design, which best analysed all the above aspects.

1. Introduction
Nowadays the public, especially people with disabilities such as physical, sensory and mental disabilities, as well as seniors, persons with temporary movement restrictions and other handicapped, placed greater emphasis to create a barrier-free environment for public places, public infrastructure and also for public buildings.

During designing a new building, the designer must consider all relevant building regulations relating to the barrier-free use of the building and apply them in his design. Usually, in case of non-compliance with these requirements, which are determined by the relevant building law, legislation
and other regulations of each country, the building permit is not granted by the competent building authority. However, the creation of the barrier-free environment in existing buildings is different in many aspects such as the type of a building, the spatial zoning of a building, the type of a load-bearing structure, the type of used building materials, technical equipment of a building and of course financial possibilities of the investor. Furthermore, the account should be taken of the existing spatial and terrain conditions of the adjacent surroundings of a building following the creation of barrier-free access to the building in the form of a walkway or a levelling ramp. These all aspects must be taken into account during designing the project documentation of a building modification, and at the same time meeting the same conditions of regulations and legislation as if it will be a new building. True, sometimes with less relief.

2. Barrier-less use of buildings in law and legislation

The issue of barrier-less usage of buildings in the Czech Republic is addressed mainly by the Decree No. 398/2009 Coll., on general technical requirements to secure barrier-free usage of buildings, which is the implementing regulation for the Act No. 183/2006 Coll., On town and country planning and building code (Building Act). Another implementing regulation for Act No. 183/2006 Coll., is the Decree No. 268/2009 Coll., On the technical requirements for buildings. Furthermore, building standards recommending parameters of individual structures for meeting building requirements such as ČSN 73 4130 Stairway and sloping ramps - basic requirements.

The Czech Building law emphasizes compliance with technical requirements for buildings and technical requirements securing barrier-free usage of the building during the request on the planning application and the building permit application. At the same time, building authorities shall exercise continuous surveillance over ensuring the protection of public interests, the protection of the rights and legitimate interests of legal and natural persons and the fulfillment of their obligations under this Act and the relating legislation. The building authority is therefore entitled, inter alia, to order the necessary modifications to the construction, building plot or on the built-up building plot, in the public interest. This may mean, for example, the requirement of the building authority to remove obstacles to the barrier-free usage of the building, as well as an order to the owner of the building to make the necessary modifications ensuring the barrier-free access and usage of land or construction. Building authorities may also decide about an exemption from the technical requirements for buildings and technical requirements securing the barrier-free usage of the building. [1]

Decree No. 268/2009 Coll. On the technical requirements for buildings that fall within the competence of the general building authorities. The decree includes technical requirements for buildings, requirements for safety and character of buildings, requirements for structures of buildings and requirements for technical equipment of buildings. The individual requirements of this Decree follow the other requirements of the relevant decrees and the requirements of Czech technical standards. [2]

Decree No. 398/2009 Coll. On general technical requirements ensuring barrier-less use of structures, provides for general requirements for structures or their parts for the security of their use by persons with physical, visual, hearing and mental disabilities, persons of advanced age, pregnant women, persons accompanying a child in a stroller or a child under three years of age (hereinafter referred to as to only "persons with reduced mobility or orientation"). As a structure it is understood all the built structures for utilization and duration period, which are made by building or assembly technology, without respect to their building technical execution, applied structural products, materials and structures. In case of requirements for common areas and equipment of an apartment building, access to all areas intended for use by the public must be granted. This requirement can be met, for example, by horizontal roads, staircases and parallel barrier-free ramps or lifts. For changes to completed buildings with access only to the entrance floor, a lifting platform may be used in justified
cases. In the case of changes to completed buildings with at least two floors that are not equipped with an elevator or a ramp and the elevator or ramp cannot be subsequently installed for technical reasons, must be ensured the barrier-less use of the entrance floor at least. There are other requirements for barrier-less use of buildings relating to the internal environment of buildings, interior and external equipment of structures and technical equipment of buildings, intended for each type of health disability or other handicaps. Technical requirements ensuring barrier-free use are also placed on public infrastructure and public spaces. The solution for persons with reduced mobility concerns the maximum height difference of walkable surfaces, characteristics of walkable surfaces and the minimum handling space for turning the wheelchair in different directions within the desired angle. Technical requirements ensuring the barrier-less use of buildings by persons with reduced mobility are concern the civil buildings, in parts intended for use by the public, common areas and building equipment of apartment buildings. They are focused on building entrances, barrier-less ramps, doors, windows, sanitary facilities and changing rooms, premises, and technical equipment in the apartment building and individual apartments with the special determination of the purpose. [3]

3. Construction-technical survey

For the design of construction modifications in the existing apartment building, to create the wheelchair accessibility, the necessary parameters of the building were identified by the construction-technical survey. [4, 5] The existing building is an eight-story apartment building with one underground floor, made of reinforced concrete panels, generally known as the “slab block” or the “panel house”, which was a typical example of the construction of apartment buildings in the Czechoslovak Socialist Republic since the first half of the 1950s. Most often there are in the form of terraced houses, multi-story buildings and separated buildings. For surveying the existing building for the possibility of building modifications, it is best to use a 3D scanner, which is used to obtain location data with high accuracy. [6, 7]

The type of apartment building solved is a modification of a structural system known as the T06B, which development had been in progress since the late 1950s and which was created by the evolution of the G57 structural system. Construction of this structural system began in the first third of the 1960s and is the most common structural system located in the Czech and Slovak Republics, of course in several variants. The structural system is characterized by a unified span of 3.60 meters with a transverse support system with longitudinal stiffness, or possibly it can have a combined support system. The structural height of the building (from floor to floor) is 2.80 meters, clearance height is 2.60 meters. The transverse support system is complemented by a pre-fitted curtain wall, which consists of a full-wall layered reinforced concrete panel of 0.22 meters thick, which is suspended in the façade. The curtain wall is filled with thermal insulation of polystyrene thickness of 0.06 meters, inserted in the middle of the panel. Internal wall panels are reinforced concrete thickness of 0.15 meters. One section of the terraced apartment building usually consists of five modules with the unified parameters. The T06B construction system has often been modified by construction companies in different regions, for example by changing the layout or by changing the design of the façade. There was also a lot of experimentation with a concrete mixture composition of individual curtain walls variants. The composition of the curtain wall is made of concrete panels with slag and pumice admixture, of concrete panels with expanded clay and pumice admixture and ceramic sill panels.

The solved apartment building requires the design and implementation of wheelchair access due to the existing solution of the main entrance into the building and the overall layout-technical solution of the building related to the staircase and elevator shaft, which provide access to individual dwelling units on all floors. The existing entrance to the building is only one and it is located on the northern façade. The entrance door threshold is above the height level of the adjacent terrain and the walkway leading to the entrance into the building. The height difference between the entrance door threshold and the access walkway is solved by a leveling exterior staircase with a small handling area in front of
the entrance door. Behind the entrance door, there is a wind lobby, from which it is possible to enter a staircase landing platform between the basement and the first floor. The wind lobby is separated from the stairwell by the internal door. The staircase type is half-turn with 180° flat turn and with the space between stair flights, where is located the elevator shaft. The entrance to the elevator is allowed only from the basement or from the upper floors, but not from the staircase landing platform, which follows the main entrance into the building.

During the technical survey inspection, which was carried out in May 2018, the parameters of all major structures inside the building were measured and defined for the late design of the wheelchair accessibility. The measuring of the existing state of the apartment building was carried out using the Leica DISTO X310 hand laser rangefinder with an accuracy of ±1 mm to 120 meters and with a built-in angle measuring instrument of 360°. The height difference between the entrance door threshold and access walkway is 0.90 meters, the same is the depth of handling area in front of the entrance door. The exterior staircase contains five stair steps with the rise height of 0.18 meters and with the going width of 0.30 meters. The total length of the stair flight is 1.50 meters, the width of the stair flight is 2.00 meters. The wind lobby is 3.10 meters wide and 1.10 meters long. The entrance and interior doors are two-wing, 1.50 meters wide, with the opening in the direction from the interior to the exterior. The space of the core, where is located the stairwell and elevator shaft, is 3.60 meters wide and 4.30 meters long. The staircase type is half-turn with 180° flat turn, with two stair flights, each width of 1.20 meters containing eight stair steps with the rise height of 0.175 meters and with the going width of 0.28 meters. The elevator shaft with the entrance in the basement is located between the stair flights. The width of the corridor in the basement and the width of the staircase landing platform is 1.03 meters. Cellar units are accessible from the corridor in the basement. Figure 1 shows the current state of the main entrance into the building and the internal service core with the stairwell and elevator shaft.

![Figure 1. Existing entrance floor plan](image)

4. Design of wheelchair accessibility
The result of the technical survey revealed the current state of the main entrance to the apartment building and the data from the measurements were used in the design of the wheelchair accessibility.
At the same time, the proposal for barrier-free access was based on requirements according to the Building law and relevant legislation, building standards and other regulations valid in the Czech Republic.

Due to the existing solution of the design of the non-level main entrance to the building, any proposal design of barrier-free access would entail extensive construction modifications to the existing entrance and service core with staircase and elevator. The height difference between the main entrance door threshold and the adjacent walkway means the creation of a barrier-free ramp and handling area in front of the building entrance. The ramp should be at least 1.50 meters wide, with a maximum longitudinal slope in a ratio of 1:16 (6.25%) and transverse slope in a ratio of 1:100 (1.00%). The wheelchair ramp longer than 9.00 meters shall be interrupted by a landing wide of 1.50 meters at least. Modifications of existing buildings deal that if the wheelchair ramp is not longer than 3.00 meters, the longitudinal slope may not be more than 1:8 (12.5%). [8] This does not apply to buildings with special-purpose apartments for persons with severe movement disabilities. This, with the current state of elevation between the entrance and the adjacent terrain of 0.90 meters, would mean the creation of the wheelchair ramp with an unroll length of 14.5 meters without landing. Simultaneously handling space of the main entrance to the building, of the wind lobby and the stairwell does not meet the requirements for the barrier-free environment. These recommend a minimum handling space for turning the wheelchair in different directions within an angle that is greater than 180°, a circle with a diameter of 1.50 meters and the smallest space for rotating the wheelchair by 90° to 180° is a rectangle measuring 1.20 meters to 1.50 meters. The dimensions of the service core and the inner stair do not allow the installation of the lifting platform. For the above reasons and expected financial costs, the method of creating barrier-free access to the building was chosen not through the existing main entrance, but by the created new door hole in the curtain wall on the southern façade. This solution is conditional on interference with the existing load-bearing structure to create a door opening, together with the creation of an internal wheelchair ramp and an external access walkway, but it is the feasible solution without spending the large financial and material resources.

The proposed solution of the barrier-free access into the building is considering creating a door opening in the existing reinforced concrete panel of the curtain wall on the south side of the facade. Thanks to this, a new entrance room will be created in the basement of the building, in the premises of the existing cellars, with a direct connection to the service core with stairwell and elevator. The need for an indoor wheelchair ramp arises from the different height of the floor inside the basement in the building and the adjacent terrain in the exterior with an elevation of 0.32 meters. The creation of the internal ramp will ensure that the height difference of the walkable areas, which must not exceed 0.02 meters, will be met. In the case of the landscaping outer adjacent terrain for the purpose to construct the access walkway to the ground floor level, there would be a risk of flooding by rain and surface water flowing into the building, due to the slope of the access walkway falling towards the building. The current slope of the adjacent terrain is the opposite, thus naturally diverting rain and surface water away from the object.

The room of the existing cellar is 3.44 meters wide and 5.95 meters long with a clearance height of 2.60 meters. Its proportions are suitable for creating barrier-free access containing barrier-less entrance with handling area and wheelchair ramp. The first step was to cut the door opening into the existing reinforced concrete panel of the curtain wall, measuring 1.50 meters in width at 2.06 meters high, with the lower edge of the threshold at a height of 0.32 meters above the floor. First, however, grooves were created in the perimeter panel, at the point of future entrance, on both sides of the existing wall, for future insertion the horizontal reinforcement bars with a diameter of 12 mm. After installing the additional reinforcement, the opening of the future entrance was cut into the panel, using a diamond saw. Subsequently, the wheelchair ramp with a width of 1.50 meters and a length of 2.75 meters with a maximum possible slope of 1:8 (12.5 %) was carried out. From the ramp connecting handling area in
front of the door from the building, was carried out with dimensions of 2.47 meters in width and 2.08 meters of depth, thus fulfilling technical requirements for ensuring the rotation of the wheelchair in the necessary directions. The handling area also includes two stair steps with a height of 0.16 meters and a depth of 0.26 meters. The construction of the ramp and handling space is from reinforcement concrete. The surface of the ramp floor, handling space and the rest of the room is made up of ceramic tiles with anti-slip treatment. The ramp and handling area is equipped with a stainless steel railing with a handle height of 0.90 meters and 0.75 meters, anchored to the structure of the ramp or the wall, with stainless steel rail of a height of 0.10 meters on the bottom of the rail. The new entrance door is two-winged with a total input width of 1.50 meters, with the main opening door wing being 0.92 meters wide. The clearance of the door is 1.97 meters. The door is fitted with a 40 mm thick stainless steel handle on the inside with a height of 0.9 meters. The direction of opening the door is out of the building. As part of improved accessibility of the stairwell and elevator, the existing door opening between the rooms was removed, thus ensuring a smooth transition from room to room. The remaining works included insulation of the ceiling structure, the execution of new lighting and the execution of painting works. The design and implementation of the barrier-free access in the apartment building are shown in Figures 2, 3 and 4.

![Figure 2. New barrier-free entrance floor plan](image-url)
5. Conclusions
The design of the barrier-free environment in public transport, public places and public buildings and buildings, in general, is a necessary part of today's planning, design and implementation of structures, whether new or existing. During the design of the barrier-free environment, it is necessary to follow the relevant building law and other applicable legislation, including building standards and other regulations, and at the same time, propose measures for a given type of disability or other handicaps.
For existing buildings, it is required to carry out the technical construction survey of the current condition of the building.

The solution of the design described by the example of wheelchair accessibility of the apartment building fulfilled all the above-mentioned aspects related to the barrier-free environment. Thanks to the correct design, the building modifications were approved by the competent building authority and construction could be carried out. Barrier-free accessibility of the apartment building in Kraslice city, improved the quality of life of residents, especially the elderly and people with reduced mobility. The described solution can serve as an inspiration in similar cases of the barrier-free access to the existing apartment buildings.

References
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