MODULE 3

AGE-FRIENDLY BUILT ENVIRONMENT – ARCHITECTURE

UNIT 4

APARTMENT SPACES

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DESIRE

DESIGN FOR ALL METHODS TO CREATE AGE-FRIENDLY HOUSING

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DESIRE will provide professionals in the building industry and home furnishings sector with the tools and skills to apply Design4All methods as an integral part of the design process, with the aim to create or adapt age friendly housing as a solution for the wellbeing, comfort and autonomy of the older adults or dependents at home.

The DESIRE training platform consists of six modules and 21 units.

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UNIT 4 – APARTMENT SPACES

A basic prerequisite of human satisfaction is healthy housing capable of responding to all phases of the life cycle or to the needs of different people. Older people and people with disabilities should have housing that supports independent, active, and healthy living. Therefore, when housing units are created, it is recommended to apply the human-centred design methods, such as Universal Design/Design for All which achieves the desired harmony of design with diverse human needs. Integrating "Universal Design in the procurement, design, construction, management, and use of the built environment contributes to sustainability, providing buildings and spaces that are accessible and usable for all and adaptable for future use and user requirements." (EN 17210:2021 A: p. 21)

In new construction, human-centred design must be implemented as early as the initial stages of creating a detailed design, which will demonstrably reduce the costs of accessible solutions while attaining optimal results from the point of view of user needs. A conducted study (Meyer-Meierling, 2004, p. 4/8) proves that the costs of accessible construction are the lower, the sooner the implementation of a barrier-free solution is considered.

When designing a universally accessible apartment, it is recommended to consider a **combination of adaptable and fixed elements**. The mentioned combination of elements will create a flexible environment that can be additionally adjusted according to the current needs of the apartment users (Rollová, Čerešňová, 2015, p.13). The basic principles of applying adaptable and flexible elements in a universally accessible environment were defined by R. Mace in 1991. Among the adaptable elements, Mace included (Mace, 1991, p. 161) for example, movable and adjustable elements and equipment, adjustable height of interior elements, or mobile storage systems. Among the fixed elements, he mainly included elements of the construction system of the object (corridor and aisle width with the possibility of creating manoeuvring spaces for turning the wheelchair, installation of control elements within the reach of a seated person, load-bearing walls with the possibility of additional installation of handholds (according to the individual needs of the user), etc. The inexpensive elements include, without limitation, ergonomic opening mechanisms or colour-contrasting interior design (door and wall, stairs and wall, etc.).

In order for new housing units to provide the required flexibility of spaces, the architect should **apply the principles of adaptable design** when creating them, which allow easy adjustments to the apartment layout in a short time with low costs (further information provided in M3 chapter 3.2 Accessible, safe, flexible, and adaptable design of residential buildings). Adaptable apartments will significantly increase user quality in the long term, as it is likely that the demands and abilities of different users will change over the lifetime of the building. The argument of "visitability", i. e. providing the possibility to visit the apartment users together with friends or family members, who may have various temporary or permanent disorders of mobility or sensory perception, is also important.

4.1 APARTMENT SPACES LAYOUT (FLOORPLAN) AND DIMENSIONS

IN A NUTSHELL

The adaptable house or flat is designed so that it can be used by all people and has the possibility of further modifications if it is necessary for the future needs of the family, the older adults or people with disabilities. This may include simply modifying the kitchen and bathroom to improve access and independence, raising lighting levels in response to visual impairment, or introducing support devices such as railings and other security measures.

As mentioned above, the construction of adaptable apartments is preferred for them being accessible to and usable by a wide range of users with different needs and abilities. They include accessible design elements, especially wider doors, a reasonably large floor area, switches, and controls located at a lower height. An adaptable apartment does not have to be fully accessible from the start of use, but must allow for the selection of accessible elements or accessories that can be modified or added if necessary to better meet the various specific access requirements of users. “Adaptable housing design is affordable, especially over time, because it reduces the need for people to move or make costly and disruptive structural modifications by building flexibility and adaptability early on.” (EN 17210:2021 A: p. 214)

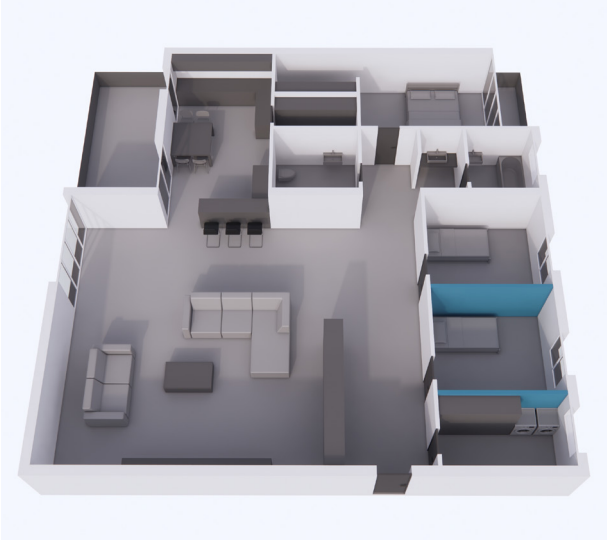


Figure 3.4.1 Adaptable apartment and removable walls that allow changes in the number or size of rooms (Rollová, Suláková)

The adaptability of the apartment layout can also be ensured by **removable walls** in which no installations are built (electric cables or water pipes). Figure 3.4.1 shows an example of an adaptable apartment, where a family can adjust, thanks to removable walls, the number or size of rooms depending on the family needs. The separate toilet room is enlarged to provide enough space for manoeuvring a person in a wheelchair or for assistance. The larger toilet room is also comfortable for household members without disabilities, there can be a bidet or a washing machine in the room, and everyone can simply use the space according to their own needs.

The living area of the apartment has the character of an **open layout**, which provides enough space for a variable arrangement of furniture, and the kitchen corner has a large floor area allowing to manoeuvre even a wheelchair. An apartment designed in this way is just one example of a variable apartment solution; the architect has the opportunity to apply these principles to any layout of the apartment.

The greatest demands must be placed on a good bathroom design, so that it can be easily adapted to the household needs. In Figure 3.4.1, there are two bathrooms in the apartment, which can be modified according to the current needs of the family. The bigger bathroom is designed in such a way that one sink is accessible separately (in front of the room), which is an advantage for a multi-member household. The bathroom on the left has the minimum dimensions of an accessible bathroom (Figure 3.4.2), but it can serve several purposes, for example as a toilet with a washing machine, a toilet with a bidet, or as an accessible bathroom with a roll in the shower. Then, there is the option to additionally mount handles. As has been demonstrated, the architect must take into account these modifications and prepare everything to work without demanding structural modifications. **A floor drain is an integral part of the hygienic spaces (bathrooms and toilets) allowing to shower next to the bath or toilet, if necessary.**

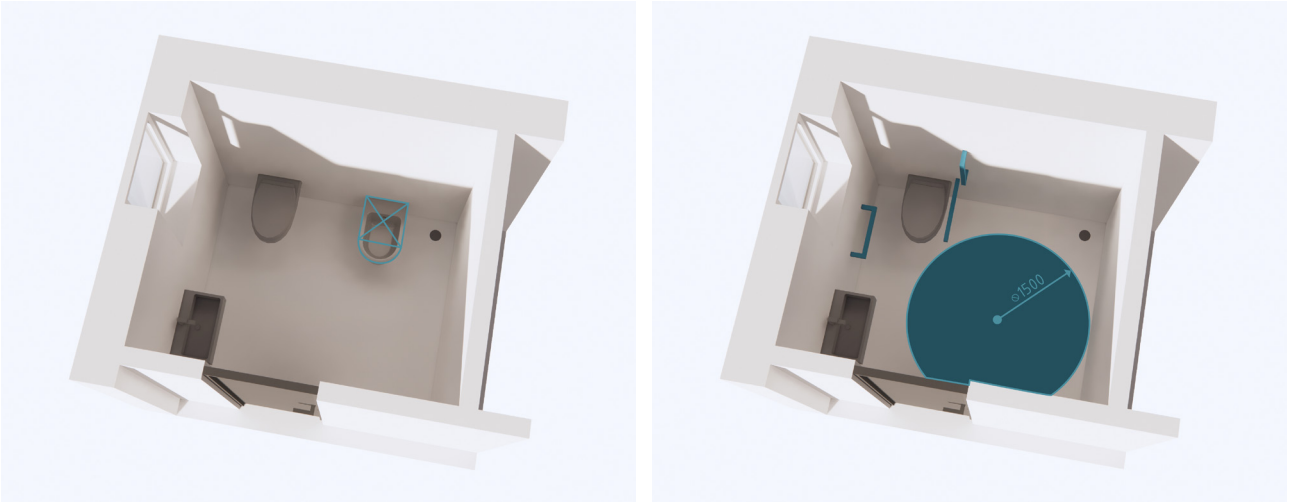


Figure 3.4.2 a, b A variable bathroom solution (Rollová, Suláková)

The following requirements and recommendations apply when creating an apartment layout:

a) Corridors or halls within the apartment must have an adequate width (at least 1,400 mm) so that persons using mobile devices on wheels or walking aids can easily move and manoeuvre around and enter all rooms.

b) Furniture arrangement in rooms for various purposes, e. g. cooking, hygiene, sleeping, living room, storage, etc., is designed with an adequate manoeuvring space for at least one person using a mobile wheeled device. The aisles between the furniture must be at least 900 mm wide, and it must be possible to create a free space of 1,500 mm in front of the cabinets, allowing enough space for handling.

c) In apartments with two or more floors, there is a living room, a kitchen and an adaptable toilet at the entrance level with a space and drain allowing for the installation of a shower, but also one room with space to place a bed if necessary.

d) If there is a separate storage or laundry room in the apartment, it must have sufficient space for manoeuvring mobile wheeled equipment that allows easy access and use of the equipment.

e) Switches, sockets, ventilation and service controls must be easy to use for everyone and at a height that can be reached by sitting and standing persons.

f) Bedroom lighting must be controlled by two-way switches, one of which is located by the door and the other by the bed.

g) Electrical supply should be provided near windows to allow installation of remote-controlled window controls, blinds and curtains/blinds.

4.2 HORIZONTAL CIRCULATION

IN A NUTSHELL

Horizontal circulation in the building includes **entrances and exits, internal lobbies and vestibules, and corridors**. It is mainly affected by the appropriate layout design and building construction. It may include access routes through open spaces, corridors, and lobby areas. The general layout of the horizontal circulation should be as logical, understandable, usable, and direct as possible to provide access to all users. Travel distances should be reduced to a minimum, but this naturally depends on the type and size. The design of well-designed buildings and clear and easy-to-follow circulation paths will benefit everyone. Floor height differences in the building must be avoided as much as possible. In the case of an existing building that has floor height differences, it may be necessary to consider and design vertical circulation such as ramps, passenger lifts, or platform lifts because of accessibility.

4.2.1 Entrances and exits

The entrance must be easily found and clearly distinguished from the exterior space. The location of the entrance can be highlighted by architectural features such as the canopy and door recesses. Changes in the surface textures of the pavement and entrance space can help indicate the position of the entrance, especially for people with visual impairments. Audio clues such as small fountains or plants, and olfactory features can also help. Artificial lighting highlights the entrance of a building and makes everyone visible at night. Entrances are also typically used as evacuation and emergency exits; buildings may have multiple accessible entrances, but it is unacceptable for persons with different abilities to use only secondary or alternative entrances.

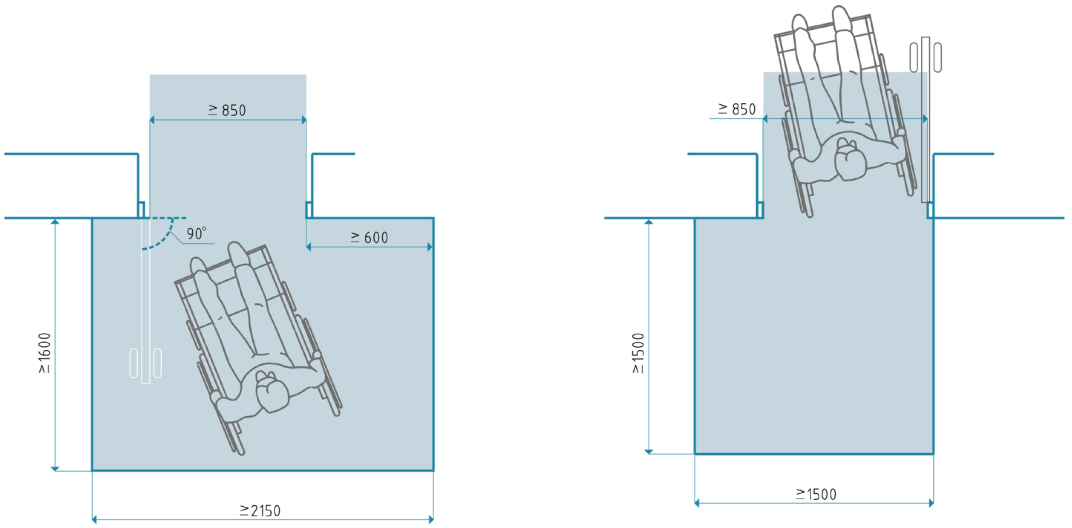
Accessible entrances allow all users to access and exit buildings and places safely and independently. The entrances to the building or site should be designed to provide equal access to all users. Building entrances may need to function in potentially contradictory ways, such as allowing certain users to access controls and denying other users access for security reasons. An entrance hallway or passage is a common space with external and internal door arrangements and is often necessary for security, climate conditions, or safety.

- The main entrance must be covered to form protection against rain or snow for people waiting outside. Weather protection is particularly useful when security or access devices are needed before entering buildings. The depth of the door recess and the canopy should be 1,200 mm and the head height should be at least 2,200 mm.
- Visual identification methods for improving perception, such as visual contrast and improved lighting, should be provided.
- A suitable tactile indicator should be provided, such as changing the surface texture of the parking lot or front yard or providing Tactile Walking Surface Indicators (TWSI) to guide the user to the entrance. If a tactile surface is applied, this should

continue as needed, for example, at the reception point or the information point.
- If the entrance is at a level different from the level of the surrounding ground, the appropriate slope and ramp approaches and landings must be provided just outside the main entrance.
- All permanent or temporary features provided on the floor to limit the flow of dust or water should allow an easy passage without the risk of falling or sliding.
- Where gratings are provided in front of the outer doors to prevent dirt, snow, soil, or sand from entering, the slots in the grating must run across in the travel direction and shall be flush and well-drained. Groups integrated in visual and tactile entrance systems contribute to acoustic orientation. The small metal grating above the entrance allows guide or assistance dogs an easy access. The coating is well fixed in the drain with a maximum slot width of 10 mm and a maximum slot length of 20 mm.

4.2.2 Entrance space

- Entrance spaces should provide a sufficient operating space for people using wheels to turn; they must provide a turning space in front of the entrance door, beyond the door or the door ring. The minimum horizontal manoeuvre space is **1,500 × 1,500 mm** in front of the opening door of the building. The minimum horizontal operating space is **1,600 × 2,150 mm**, with a 180° rotation of a person in a wheelchair.
- If an open-out door is located near the steps or the ramp flight, it should be placed so that no one falls backwards at the opening of the door. Doors open to the outside, are preferably recessed, with horizontal landings of at least 1,600 × 2,150 mm, without the door swing.
- The door latch must have a clear space of 600 mm so that a user in a wheelchair can operate the handle.
- Crossing traffic should not be obstructed in front of the entrance to allow unauthorised access.



a) Example width of door opening towards user

a) Example width of door opening away from user, with minimum circulation space

Figure 3.4.3 Entrances (Suláková according to EN 17210:2021)

In multistorey buildings, accessible entrances must allow an easy access to an accessible lift located in a convenient location. Entry to the building from the underground or multi-storey parking lot is accessible and consists at least of a lift accessible or a direct entrance. The main entrance to the building must be identified or marked from the land borders and the parking lot.

4.2.3 Entrance doors

The entrance door must be wide enough to allow all persons, including people with mobility devices and tall people, to enter freely. The entrance and lobby doors have a minimum width of 900 mm and are preferred at 1,000 mm, with a minimum clear height of 2,000 mm.

Type of main entrance door according to the EN standard

- Side-mounted automatic doors must have an adjustable delay closing mechanism.
- Revolving doors must be avoided because they are difficult to use and hazardous to people using wheelchairs, canes, guide dogs, and assistance dogs, as well as people with lower balance.
- The handle, pull, latch, lock, control is located between 800 mm and 1,000 mm above the floor, preferably at 900 mm.
- The handle and hardware of the door is located 30 mm from the edge of the door.
- All door opening hardware can be operated by one hand without requiring grasping or turning, and should preferably provide lever action.
- The glazed door should be marked – the visual indicator is at least 75 mm high, contrasted to the background and at 900 – 1,000 mm and 1,500 – 1,600 mm above the ground level, or an opaque strip on the opening edge of a frameless glass door with a minimum width of 25 mm, visually contrasted with the surrounding environment.

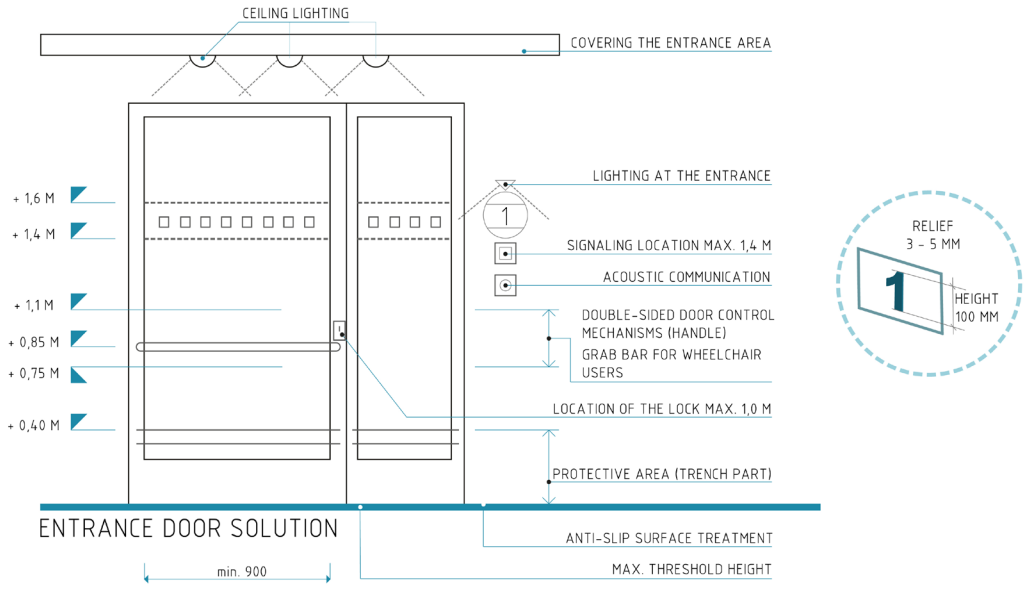


Figure 3.4.4 The entrance door (Rollová, Suláková)

4.2.4 Entrance lobby and vestibule

An entrance hall, that is, an external and internal door arrangement, is common in many buildings and is often necessary for safety or climate reasons. The creation of a lobby should not be considered mandatory, unless the external door and building design is capable of functioning without it. Even the most accessible doors can cause potential obstacles and reduce the available space. Therefore, if there is no need for a lobby, the lack of a lobby entrance is probably a better solution.

Where appropriate, the entrance lobby must be as large as possible and provide sufficient space for everyone to move between the internal and external doors. The minimum uninterrupted operating space between the doors is 1,500 mm from the swing of the door, with a single swing door opening outside. The total size depends on several factors, including the type of building, the number of people who will use the entrance at any time, whether it is used simultaneously as an entrance and exit, or need security features.

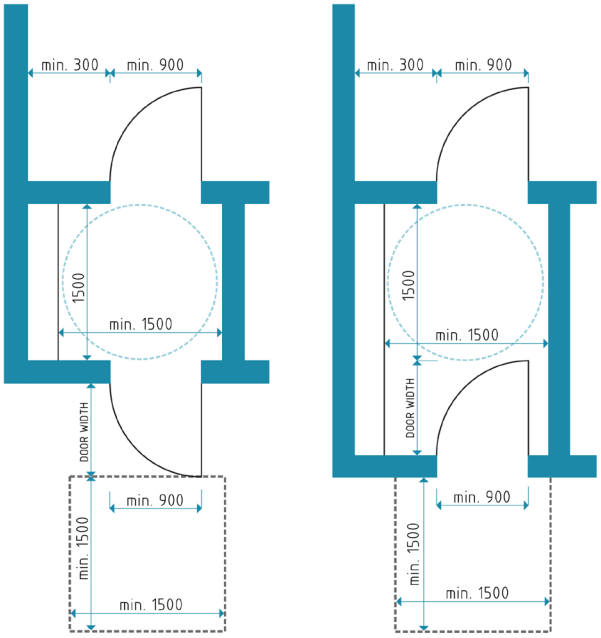


Figure 3.4.5 The entrance area (Rollová, Suláková)

4.2.5 Corridors

Corridors are the main spatial unit of the circulation system of a building and must be easy to follow. People must be able to easily find their way without restrictions. The corridors will enable all persons to open and close the doors and to enter the room and the facilities easily and independently, by passing without obstacles or turning in a wheelchair. They should be designed without steps, if necessary, they should contain ramps to overcome small differences in level, provided these cannot be avoided. To minimise collision hazards, doors must not open into corridors. In addition, accessible toilet doors should open outside, and if the corridor is sufficiently wide, the door allows clear passage when fully opened, and it must be clearly marked. The overall design of the corridors and passages of the building must be as direct as possible. The distance to travel must be minimised in accordance with the type and size of the building.

The minimum width of corridors in residential buildings is 1,500 mm. The objects projected into corridors such as heaters, or fire extinguishers can pose a risk to all users. The width of a corridor may be reduced to a minimum width of 1,200 mm in small distances

if it is limited by local obstructions such as service conduits, fire rods, and columns.

- Corridor floors must be arranged as much as possible so that all users can move comfortably and safely.
- The minimum clear height of corridor and passageway passages shall be 2,400 mm above the floor surface. If corridors run next to staircases, ramps, stairs and ceilings are limited, protection must be provided to detect warning or other barriers at an appropriate height above floor level to prevent user collisions.
- If the corridor in a flat house is less than 1,500 mm wide, there should be passing places of 1,800 mm and 1,800 mm at an interval of up to 20 m between.

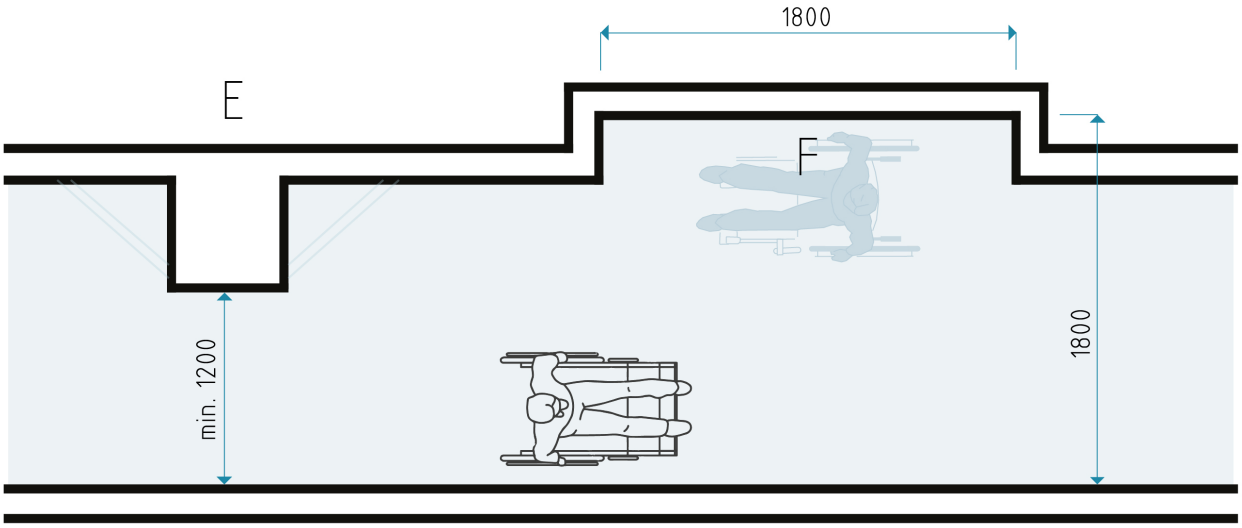


Figure 3.4.6 Minimum corridor width allowing a 90-degree turn while using a) small sized mobility devices, b) larger wheeled mobility devices (Suláková)

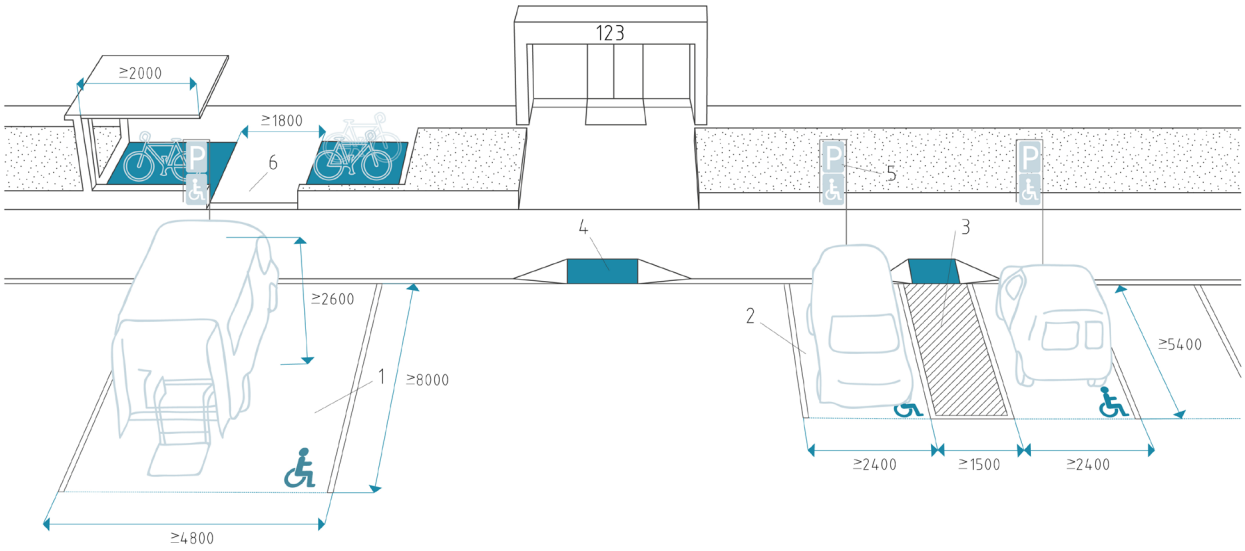
4.2.6 Auxiliary premises

Auxiliary premises include areas that support the primary function of the building. They are not part of the primary purpose of the building, but are required and add useful value such as: parking areas and garages, common storage areas, plant, cleaner and garbage rooms.

Accessible garages contain designated parking spaces for persons with disabilities located as near as possible to the main entrance of the building. According to the EN standard, at least one accessible parking space must be available in any parking area up to ten parking spaces. This increases to at least four and eight in parking areas with up to fifty and one hundred parking spaces, respectively.

The minimum width of accessible parking space for a passenger car is 3,900 mm, including the transfer area beside the car of at least 1,500 mm and a minimum length of 5,400 mm. Two adjacent accessible parking spaces with a shared transfer area have a minimum width of 6,300 mm. Locations of accessible parking spaces must be clearly and appropriately marked with an international symbol of access on the ground and with a vertical sign.

EXAMPLE OF PARKING SPACES FOR STANDARD CARS, MULTI-PURPOSE VEHICLES AND BICYCLES



KEY

1 LARGE PARKING SPACE FOR MULTI-PURPOSE VEHICLE
2 PARKING SPACE FOR STANDARD CAR
3 SHARED TRANSFER AREA
4 KERB RAMP, TWSI'S ACCORDING TO NATIONAL REGULATIONS, IF RELEVANT
5 VERTICAL SIGN WITH THE INTERNATIONAL SYMBOL FOR ACCESS, VISIBLE OVER PARKED CARS
6 EXAMPLE DIMENSIONS OF PARTLY COVERED BICYCLE PARKING AREA, SEPARATED FROM FOOTWAY BY TACTILE SURFACE

Figure 3.4.7 Accessible parking area (Suláková according to EN 17210:2021)

Accessible pedestrian paths in car parks and garages shall be clearly perceivable. Parked vehicles cannot reduce the clear width of an accessible route. Areas with a combination of traffic, bicycles, cars and pedestrians should be carefully considered. It may be very difficult for a person with vision impairments to safely follow a route.

4.3 VERTICAL CIRCULATION

IN A NUTSHELL

Because of accessibility, the lift is the optimal component for overcoming height differences and floors. There should be a lift in every new residential building, which will ensure accessible overcoming of height differences between floors. Small height differences within the floor should not be designed in new buildings. In existing buildings where the level change is higher and there is no space for an elevator and the installation of a ramp is not practical, it should be considered to provide a vertical platform lift rather than an inclined platform lift. Although stairs are the most common way to overcome level differences, they can cause serious injury after fall. Therefore, it is essential to design stairs to ensure that they are safe for everyone, also in an emergency.

4.3.1 Ramp

Ramps provide accessible routes to people unable to use stairs because there is already a level change that cannot be avoided. Some people, including those with strollers, wheeled luggage, or using wheelchairs, need ramps. The design of ramps is essential for their usefulness and safety. Any ramp must have an adequate and constant gradient. When using a wheelchair, a steep ramp can be difficult to climb and increases the risk of falling. The need for an adequate manoeuvring space at the top and bottom of the ramp and direction change is also an important factor in ramp accessibility. During regular landings on the long ramp, the person can rest; the minimum length of a landing is equal to the ramp width.

The building should be designed so as ramps are avoided as much as possible on the internal circulation system. If a ramp is required, carefully consider the existence of an elevator/ lift or a lift platform. If the slope on the access route is less than 1:20 (5.0 %) it means there is a **sloping path**. If it is greater than 1:20, a ramp landing and handrail is needed. Because of causing difficulty to people using wheelchairs, curving ramps should be avoided.

- According to the EN standard, the approach to the ramp at both ends is highlighted by coloured indications or visual contrasts to indicate its existence and facilitate the use by diverse users, including people with vision impairment. Ideally, ramp approaches should be near the location of lifts (or lift platforms) and stairs.
- Ramps must have adequate constant gradients and the length between the landings is necessary to facilitate a comfortable, safe, and independent use. Long ramps with total rise greater than 2,000 mm must be accompanied by accessible lifts.
- The width of the clear surface and the width between the handrails must allow all people using wheeled mobility devices, including people in wheelchairs, to pass without obstruction. The ramp width must be determined depending on the expected level of use and the possibility that people will use the ramp simultaneously in both directions. The minimum horizontal distance between handrails is 1,000 mm for one person in a wheelchair, 1,500 mm for two-way traffic permitting a walking person and a person in wheelchair to pass each other; 1,800 mm

Examples of rises, gradients and lengths of ramps

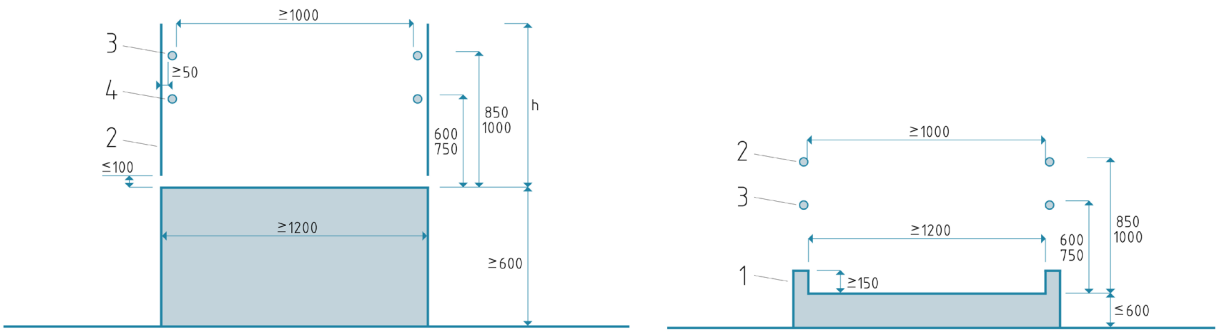
Example application	Maximum rise (mm)	Gradient (rise in length) (%)	Maximum length (horizontal projection) between landings (mm)
Sloping path	No limit	Less than 1 in 20 (5.0%)	No limit
Ramp	500	1 in 20 (5.0%)	10 000
Ramp	500	1 in 18 (5.6%)	9 500
Ramp	375	1 in 16 (6.25%)	6 000
Ramp	263	1 in 14 (7.14%)	3 500
Ramp	210	1 in 12 (8.3%)	2 260

NOTE: A ramp with a gradient higher than 1 in 12 (8.3%) can be difficult or impossible to use for some persons with disabilities and can create an increased risk of injuries due to fall or tripping.

Figure 3.4.8 Correct ramp dimensions (Suláková according to EN 17210:2021)

is required for two wheelchair users to pass each other.

- At the top and bottom of the ramp, level landings are placed and direction changes are made to allow pedestrians using wheels to move and manoeuvre in space. The intermediate landings must be performed at an appropriate interval to allow the user to rest or recover. The landing length must be at least equal to the ramp width.
- The ramp surface must be smooth and slip-resistant so that all people can move easily and safely also in wet conditions. The ramp flight must be visually contrasted with the landing surface to highlight changes in slope for persons with visual impairments. The ramp surface should not be covered with a thin and loose textile floor covering. If textile floor coverings are used, they must be fixed on a firm backing, with all edges fastened to the ramp surface.
- The ramp must have a handrail on both sides and must be continuous throughout the entire flight until they intersect with the door or travel route; they are used as a means of support, stability, safety, and guidance to users around the intermediate landing, except when they intersect with a door or path. The handrails extend horizontally above the two ends of the ramp to support the person moving from the level surface to the slope. Handrails must be set at an appropriate height for people using wheeled mobility devices, people of shorter stature or children and people who have difficulty walking, balancing, or moving. According to the EN standard, the ramp must have edge protection, a continuous upstand with a minimum height of 150 mm, or rail with its lower edge of maximum height of 100 mm from the ramp surface. Handrails should also be 850 – 1,000 mm above the surface of the ramp, the second lower handrail between 600 and 750 mm.



KEY

1 continuous rail or upstand as edge protection
2 full height panel guarding or open railing construction
3 upper handrail
4 lower handrail
h extra high guarding when children likely to climb upstand and handrails

Figure 3.4.9 Ramps' sections (Suláková according to EN 17210:2021)

4.3.2 Lift

In general, passenger lifts are the most practical way to overcome distance between the floors of buildings, especially for those who cannot or do not wish to use stairs. In multi-storey buildings, especially high-rise buildings, lifts are the most important means of access for all users of the building between the floors. Lifts are used by people with different skills and needs. It is important that all functions, including functions for regular use, emergency, or evacuation, are easy to understand and safe to use. It is desirable to consider the installation of lifts in new buildings for evacuation purposes. If the elevator is not designed according to the evacuation elevator standard, designers should ensure that there are alternative mechanisms for vertical movements for persons with disabilities, such as persons using wheelchairs.

Lifts should always be located next to stairs to provide alternative access. This is to meet the needs of those who may not be satisfied with using lifts and who prefer to use stairs to get to other floors.

Whenever possible, the passenger lift should be installed instead of the platform lift, especially in new buildings. Passenger lifts must be universally designed, capable of carrying more people at a given time, and faster than platform lifts.

To use lifts, it is essential to install appropriate lift control devices and communication systems. Especially for people with visual and cognitive disabilities. For example, careful placement, high contrast, and tactile properties help users detect, recognize, and use lifts. People with hearing impairments may have hearing communication problems; in case of an emergency, an alternative visual solution and an audio enhancement system is needed.

- Before the entrance of the lift car, the platform space must be clear with a minimum diameter of 1,500 mm to provide adequate space for the movement/operation of wheeled mobile devices. The location of the entrance to the car, particularly linked to stairs, should provide a clear space to avoid accidents.
- The minimum inner dimensions of an accessible car for one person in a wheelchair and an

accompanying person are 1400 × 1,100 mm, while leaving the car backwards. Cars of minimum dimensions of 1,600 × 1,400 mm allow persons using wheelchairs to rotate within the car.

- The width of the unobstructed entrance will allow all persons, including those using wheelchairs, to pass through. The automatic vertical sliding door is operated by electrical power. Contrast colours on surrounding walls must be specified. Minimum clear door width of cars mentioned above is 900 mm.
- All floors should accommodate level landings and provide sufficient manoeuvring space outside the lift entrance for those using wheeled mobility devices, not in any passageway or directly opposite any staircase passageway. To avoid accidents, an enlarged manoeuvring area outside the lift car will be provided in the opposite direction to the downward staircase.
- Lifts must have a comprehensible (two-way) alarm system accessible to all, including people with visual, auditory, and cognitive disabilities according to the multisensory principle.
- Landing and car control devices designed for operation should be placed between 850 and 1,100 mm above floor level, with minimum distance of 500 mm from any adjacent corner or wall.

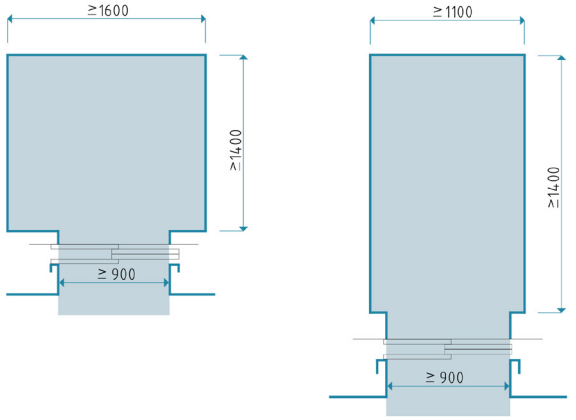


Figure 3.4.10 Suitable lift layout possibilities (Suláková according to EN 17210:2021)

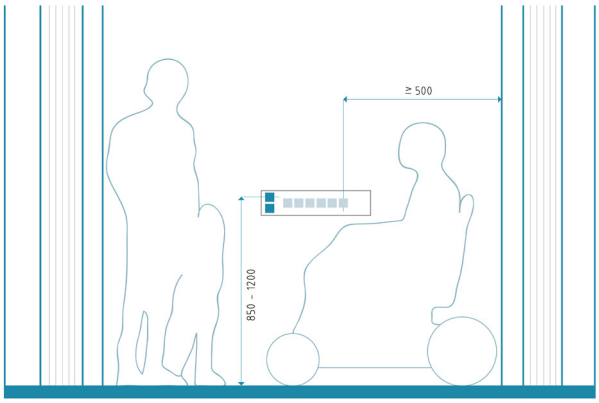


Figure 3.4.11 Suitable placement of controls (Suláková)

4.3.3 Staircase

Moving between different floors requires safe and easy-to-use steps both indoors and outdoors. When users step on them with only a part of their foot placed on the step, this can increase the probability of slipping while going down. When stairs deflect, excessive heights can cause excessive stress on the joints, knees, and/or hips of some people with walking disabilities. Furthermore, height differences often occur at the bottom and top of stairs and can cause injury, especially to osteoporosis patients. When climbing stairs, people with arthritis in the hips or knees are particularly vulnerable to trapping of toes under the projection, nosing or open riser, and the resulting tripping. Additionally, when looking at the open door, some people with visual impairments may feel unsafe, and guide dogs may refuse to continue. People with visual impairments are particularly vulnerable to falling or losing balance if they do not know the stair steps or if the steps are not designed properly.

- Optimal compositions of staircases are: straight flights, half turn with intermediate landing or large diameter curved flights with intermediate landing. Stairs with half or quarter turn without intermediate landing or spiral stairs should be avoided.

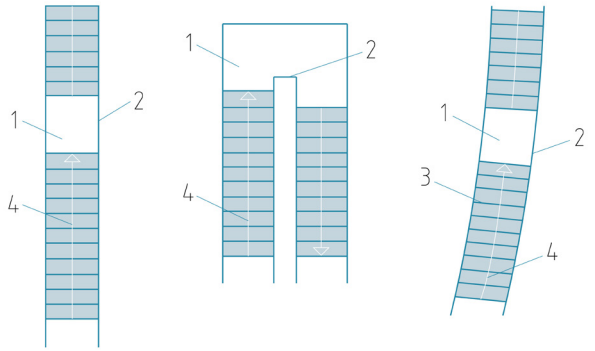


Figure 3.4.12 Optimal staircases 1 – intermediate landing, 2 – handrails, 3 – aberration of going +/-5 mm across full width, 4 – pitch line (Suláková according to EN 17210:2021)

- The stairs are accompanied by ramps or other access routes, such as lifts. If there is no technical capacity for a lift, a vertical lift platform can be used.
- There shall be no isolated steps. The flight of the stairs must be straight or, where necessary, curved stairs of large diameter can be used.
- The stairs must be wide enough to allow the passing pedestrians to move without obstruction. The minimum width of stairs is 1,200 mm and the minimum width between handrails is 1,000 mm. The minimum clear width of evacuation stairs is 1,500 mm between handrails, so that it is possible to use evacuation chairs and have space to move down while accommodating a contraflow.
- The use of stairs must have adequate headroom to avoid possible collisions of taller people. The minimum head clearance of stairs is 2,100 mm. When moving under stairs, it is necessary to provide sufficient height clearance, also 2,100 mm; or, if this is not possible, the space with insufficient height should be prevented and secured.
- Each step has a uniform rise, preventing accidents and trips, and helping people evacuate safely. Stairs must not be without risers; the steps should be stable and slip-resistant in humid and dry conditions. Maximum height of rises is 180 mm and minimum going width is 280 mm. Projection of step nosing should be avoided; if necessary, the maximum projection is 25 mm, however, in some countries, the nosing and projection must not be used at all, the stairs must have only vertical and horizontal faces.

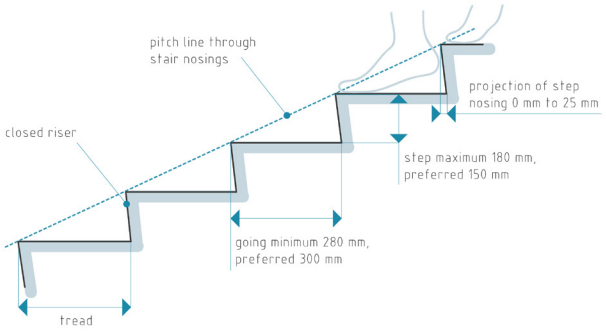


Figure 3.4.13 Stairs, in some countries, the nosing and projection must not be used at all (Suláková according to EN 17210:2021)

- Stairs must have an appropriate visually contrasting line on the front edge of all steps. A visually contrasting line of 40 mm should be set back a maximum of 15 mm from the front of the nosing. The contrast line should also return down the riser for a maximum of 10 mm.

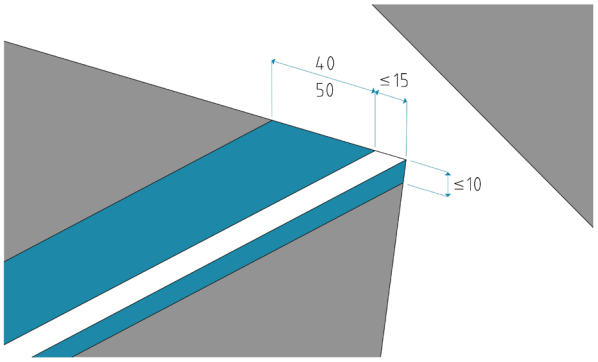


Figure 3.4.14 Contrasting stair line (Suláková according to EN 17210:2021)

4.3.4 Vertical platform lifts

Vertical platform lifts, also known as powered lifting platforms, are typical for renovation applications, and should be considered as a means of improving access in existing buildings when the installation of a passenger lift is not possible. They should not be installed in new buildings. Vertical platforms must facilitate independent, practical, and comprehensible access. It should not be necessary to obtain help or permission to use.

Platform lifts are often not suitable for many different disabilities. In addition, their use is generally limited and difficult to understand and operate. The most problematic issues with these products are the lack of enclosures or landing doors that are controlled by key operation and/or hold-to-operate buttons.
It should also be noted that they cannot be easily used by people in electric wheelchairs and that they must have a higher lifting capacity than those for conventional wheelchair users.

Vertical platform lifts should have a platform size of at least 1,100 × 1,400 mm. However, this size of platform is not sufficient for some electric wheelchairs and scooters with a length bigger than 1,400 mm when being used. To make them accessible to everyone, larger platforms should be provided as much as possible. Vertical platform lifts include doors, gates, or railings on multiple sides. This is an essential feature in which the floor level is located at a distance of less than a step in height. These “short-rise” lifts, that travel up to 2,000 mm vertical distance, usually have doors or barriers on the opposite side, allowing passengers to cross. This is the most preferred arrangement, because it avoids a person having to turn 90 degrees when entering or leaving the platform. However, if it is impossible to travel through the platform, it is acceptable to place the entrance and exit points adjacent to the platform. Vertical platform lifts are also available with three-side doors, adapted to multiple height levels.

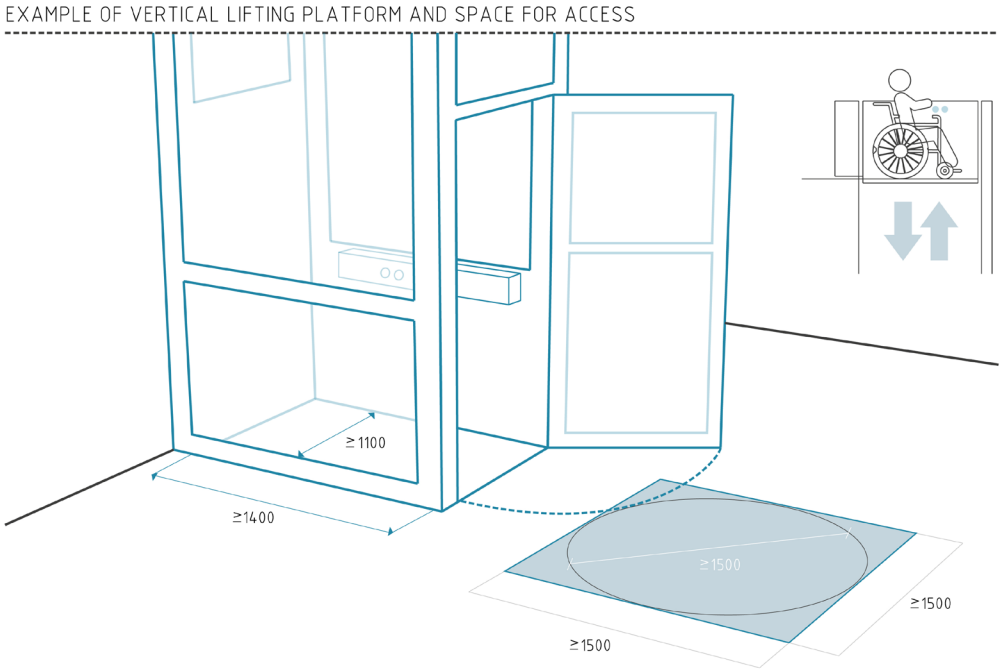


Figure 3.4.15 Vertical lifting platform (Suláková according to EN 17210:2021)

4.3.5 Inclined platform lifts and stairlifts

Inclined platforms and stairlifts travel along the stairs. They may include folding platforms for a person in a wheelchair, as well as a lift seat to facilitate the use by older people, or people with balance and endurance problems. Generally, installation in new buildings should be avoided. They can be accepted in small existing buildings where vertical platform lifts cannot be installed. They should not be used if parts of the platform or support lines interfere with the recommended clear width of the stairs, or the safety of other building users is endangered. When the unit is folded, all parts must be inserted from the circulation space and all exposed edges padded, reducing the likelihood that people may come on the platform or their clothing becomes caught on the sharp edge. Since inclined platform lifts are usually not designed for safe use in evacuation, it should be ensured that there are alternative mechanisms available to vertically move people with disabilities in emergency situations. Inclined platform lifts should only be used in buildings that are renovated, but should be available to be used independently if necessary.

Stairlifts can be used in residential architecture in exceptional cases, when adapted to meet individual needs and to be used by people fully trained to use the device. They are occasionally used in a specific place where they are provided to be used by an individual. In such areas, they should not block the specified width of stairs or emergency exit routes.

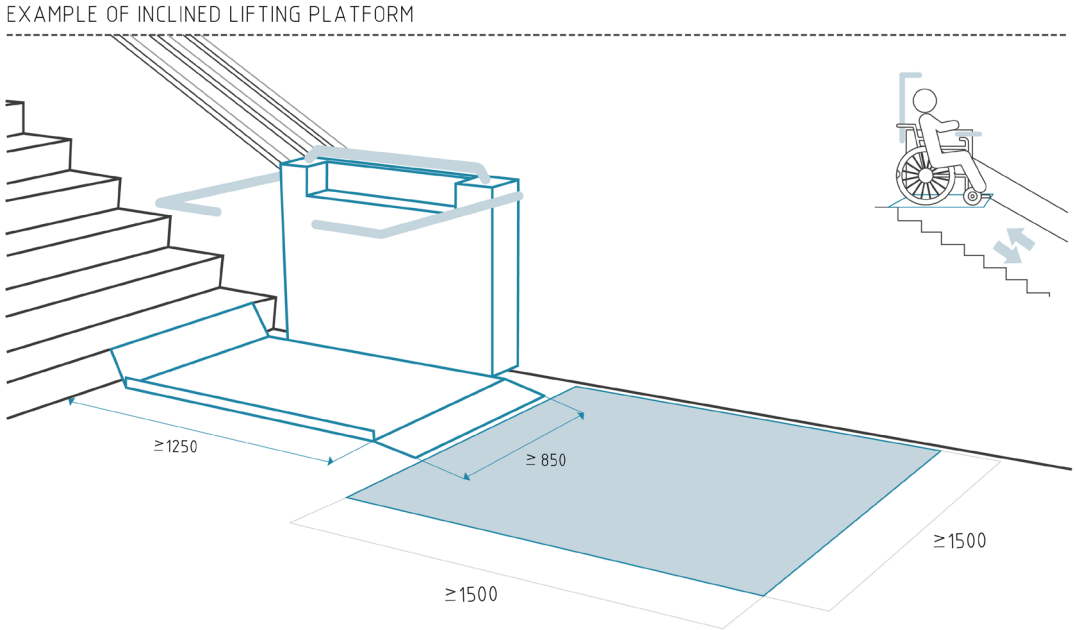


Figure 3.4.16 Inclined lifting platform (Suláková according to EN 17210:2021)

4.4 BATHROOM, TOILET

IN A NUTSHELL

Accessible and usable bathrooms and toilets are essential spaces in housing as well as in public buildings. They offer an adequate manoeuvring space and use for people who find it difficult to use general facilities, particularly people with mobility restrictions and people in wheelchairs, but they are also useful for wide range of other people, such as people with vision impairments, older people, families with small children, etc.

Adaptable solutions respond to different living situations and should be preferred in apartments due to the concept of age-friendly living and universal design. Especially in the family/ community type social care housing, in facilities for older people and people with Alzheimer's disease, location of the accessible toilet and bathroom should be indicated in multiple ways using signage: visually contrasting information, pictograms, raised tactile and Braille, so that they also serve people with visual impairments and people with dementia. Accessible toilets should be situated conveniently in **easy-to-find areas**, such as waiting spaces, receptions, near lifts, etc. The routes must be with no steps or obstacles.

In housing buildings, an accessible bathroom could be located in various layout positions. It is suitable to have the bathroom **near the bedrooms**, and a toilet or bathroom is usually also situated in the entrance corridor of the apartment. For older people, especially those with severe physical disability, it is beneficial to have an accessible bathroom near the bedroom with direct connection and the possibility of installing a ceiling lifting system for an easy transfer from the bed to the bathroom. For people with Alzheimer's disease, it is very important to have a visual connection with the doors to the bathroom.

This chapter presents information about principles and appropriate dimensions from EN 17210:2021 (A: pp. 163–172, B: pp. 129–131).

4.4.1 Bathroom layout principles including manoeuvring space for a person in a wheelchair

Firstly, an appropriate and comfortable access to the bathroom is essential. Adequate manoeuvring and transfer space is another very important feature.

An accessible toilet or bathroom **door** should be wide enough: min. 800 mm, but preferably 900 mm and open outwards from the bathroom space. The orientation of the door opening (left or right) depends on the situation in the floor plan, it is important that it simplifies the transfer from the inhabited parts of the apartment (living room, bedrooms), so that a person is not forced to walk around the door when opening it. It is necessary to consider the corridor or the space leading to the bathroom, so that there are no conflicts with other manoeuvring spaces. Ideally, the

corridor can be recessed in the area, where the door opening is located, allowing the space for manoeuvring of the person in a wheelchair – a circle with a diameter of min. 1,500 mm, opt. 1,800 mm. The circle must not collide with the door opening route. Outward opening is also necessary for easier access to the bathroom in case of an emergency.

Sliding doors are also suitable, which can save space mostly where the hallway or corridor is not too wide. Nevertheless, their disadvantage is weaker soundproofing. The door threshold can be max. 15 mm high, optimally, there is none.

The layout should be useably equipped and easy to operate. The dimensions depend on the functions they have to fulfil, e. g. people with an assistant, with larger mobility devices or a person with a mobility disability need more space. There are various layouts of accessible bathrooms and they differ among countries.

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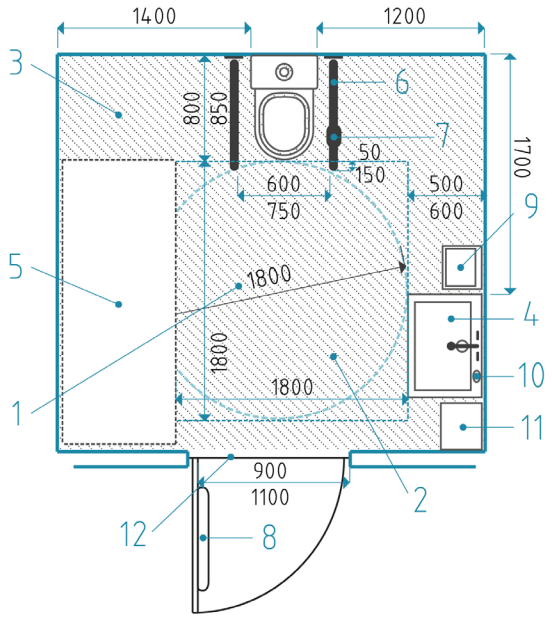
Transfer to and from the toilet seat should ideally be possible in multiple ways: frontal transfer, oblique and side transfer from left and/or right.

Individual users favour various solutions, for example, some users prefer the layout with the corner solution, where the toilet is situated next to a wall and the user can reach the washbasin and water tap, when seated on the toilet bowl. The access in this case can be from left only or from right only, depending on the position of the toilet, so it is not possible to suit all at once, because various people prefer or are able to use one side or the other. When designing multiple accessible toilets of this kind within one building, it is suitable to design both possibilities, so that users can choose.

Another layout type is the both side solution (peninsula) which allows users to approach the toilet from the left or right at the same time. This is suitable for all people regardless of their preferred side. In some countries, space for lateral transfer from both sides is required. However, in this layout the user cannot access the washbasin when sitting on the toilet, which can be a disadvantage in comparison to the corner solution, as well as higher spatial demands as this solution requires more space.

When designing an accessible bathroom for housing buildings, the toilet and the bathroom with shower and/or bathtub are usually together in one room.

The following floorplans show both solutions of a bathroom with a shower and another one with a bathtub, indicating the dimensions.



1 LARGE MANOEUVRING SPACE AND SPACE FOR ASSISTANCE
2 FULL-ROOM COVER TRACKED HOIST
3 POSSIBLE SHOWER AREA
4 LARGE TYPE WASH BASIN
5 MOBILE OR FOLDABLE AND HEIGHT ADJUSTABLE BENCH
6 FOLDABLE GRABRAIL
7 TOILET PAPER
8 PULL BAR ON INSIDE OF TOILET DOOR
9 PAPER DISPENSER AND WASTE BIN
10 SOAP DISPENSER
11 SHELF
12 EXTRA-WIDE DOOR OPENING FOR USE OF LARGER MOBILITY DEVICES

Figure 3.4.17 Accessible bathroom with shower and a bench, peninsular toilet and space for transfer (Suláková according to EN 17210:2021)

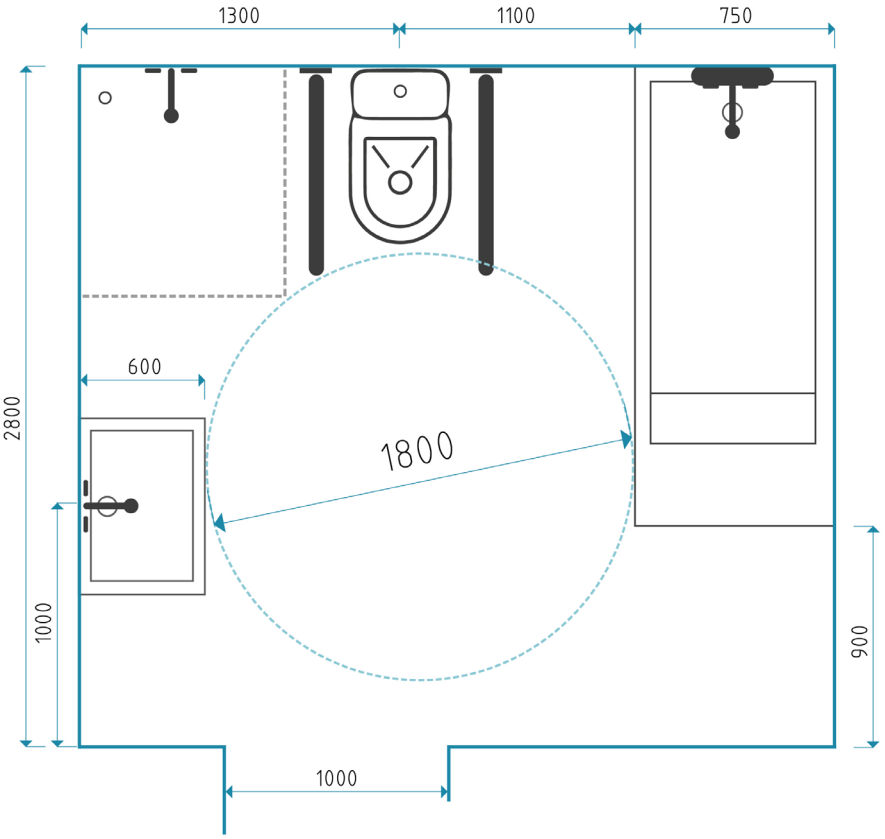


Figure 3.4.18 Accessible bathroom with bathtub, peninsular toilet and space for transfer (Suláková according to EN 17210:2021)

4.4.2 Adaptable bathroom solutions

The adaptable bathroom is realised with a view of serving as **accessible in the future**. An enlarged bathroom space can be created by merging spaces such as toilet and bathroom, toilet and storage/dressing room, bathroom and storage/dressing room, etc. A **removable partition** (e. g. made of plasterboard) between the merged spaces is only installed at the end, when the wall and floor cladding is finished and the removable partition must not be equipped with any plumbing. When creating an adaptable bathroom, it is necessary to take into account the need for a **shower at floor level**. If there is only a bathtub in the bathroom, a **floor drain** must also be implemented so that, if necessary, a shower can be installed next to the bath or toilet. New apartments in the Nordic countries have a bathtub that is not permanently built in (walled in), but is placed on legs on the floor, so that it can be easily removed if necessary. A typical and standard solution is a roll-in shower (with floor drain), located next to the toilet bowl, so that this space can also serve as a transfer space for a person in a wheelchair.

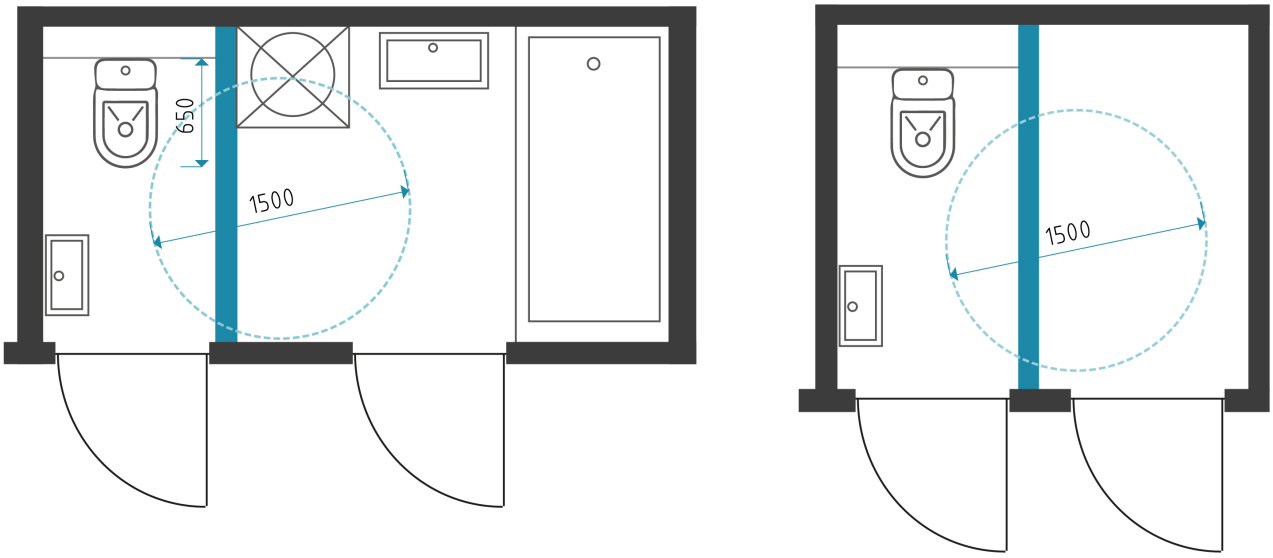


Figure 3.4.19 Examples of merging rooms together to adapt spaces for an accessible bathroom (Rollová, Suláková)

Additional equipment is added when adapting a bathroom to be accessible. In advance, we must design appropriate load-bearing capacities of the structures where accessibility devices are intended to be installed, ideally made of reinforced concrete.
The equipment consists of:

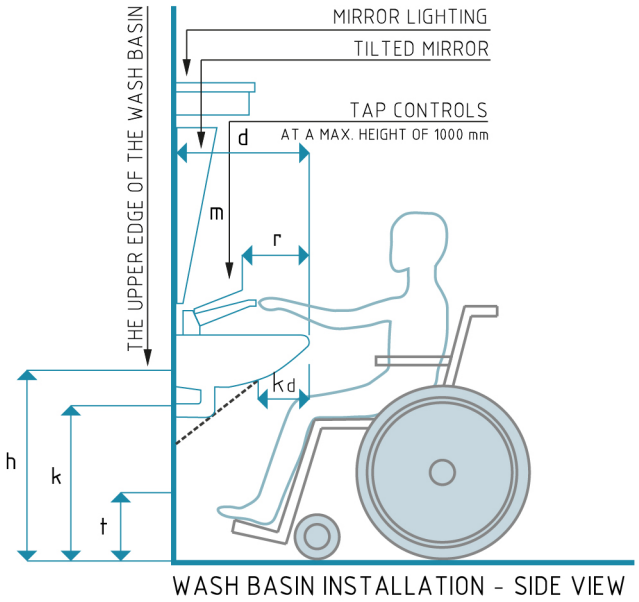
- Long handles on the door, so that people in wheelchairs can reach them.
- Foldable support grab rails next to the toilet, washbasin and in the shower according to the user's needs. The walls on which the handrails are expected to be fitted must have sufficient load-bearing capacity.
- The possibility of using the lifting device/ ceiling lift as a transport aid, pre-fitting with an electrical socket can be near the ceiling and in case of need for the lifting device, it is easy and fast to install.
- An extension to the toilet seat in order to raise it.

We can also mention **flexibility**, ability to relocate some furnishings without the need for construction interventions. For example, the bathroom may comprise a space which can be used for folding a shower tray/relocatable bath/shower cubicle with a washing machine.
In some cases, two options for entrances to the bathroom can also be designed, which can be used according to the current need, e. g. one from a corridor and one directly from a bedroom.

4.4.3 Dimensions for installation of fixtures and furnishings

Fixtures and accessories must be placed in appropriate layout positions and also height. Otherwise, they cannot function in the expected way and provide optimal and ideally independent use for all.

The appropriate layout positions of these elements are shown in chapter 4.4.1. Bathroom layout principles including manoeuvring space for a person in a wheelchair. **Appropriate heights** of fixtures and furnishings are shown below. An assistance call device (e. g. an **emergency pull cord switch or button**) should also be provided near the floor in all accessible toilets and bathrooms reachable for a person who has fallen and is lying on the floor).



h	wash basin height 750 mm to 850 mm above floor surface
k	knee space height minimum 650 mm above gloor surface
t	toe space height minimum 300 mm above floor surface
d	wash basin depth 350 mm to 600 mm
r	tap conctrols maximum 300 mm from front edge of wash basin
kd	knee depth 300 mm to 600 mm
m	mirror 900 mm to 1900 mm above floor surface

Figure 3.4.20 View of washbasin with appropriate dimensions (Suláková according to EN 17210:2021)

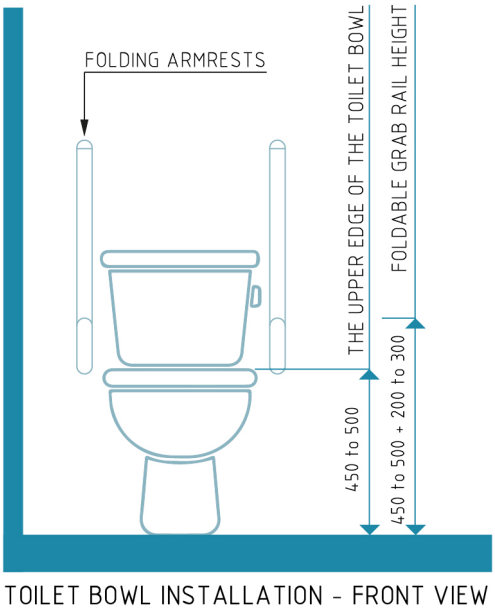


Figure 3.4.21 View of toilet with appropriate dimensions (Rollová, Suláková)

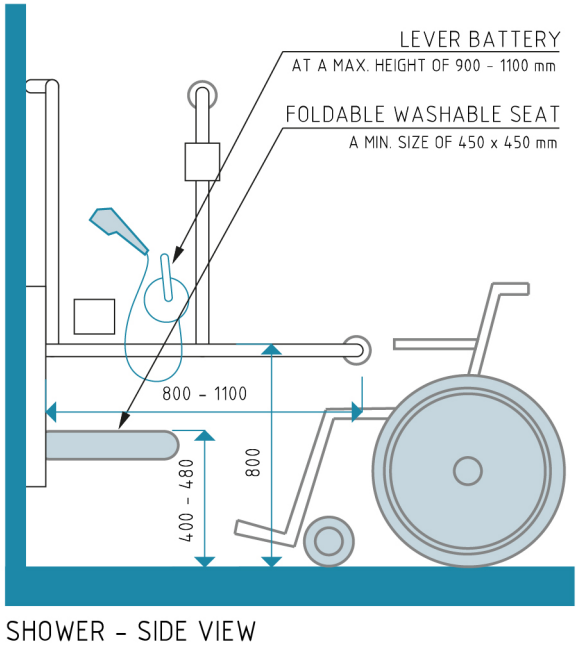


Figure 3.4.22 View of shower with appropriate dimensions (Rollová, Filová, Suláková)

4.4.4 Washbasin, toilet, shower, bath, and other items

There are many furnishings, items and a lot of equipment in a bathroom.

- An accessible bathroom needs a large type of washbasin for comfortable use. The **washbasin** must be with knee and toe space. The soap dispenser, a paper dispenser or a towel and a waste bin are located within reach. A mirror should be placed above the washbasin, ideally it should be a little inclined from the top, so that the seated person has a better view.
- The **toilet** can be longer than usual, approx. 650 – 800 mm from the rear wall on which it is installed. A back support (or cistern with a back support) is suitable, especially for older people. Near the toilet, toilet paper must be placed which can be situated on grab rails.
- The **shower** has a mobile or foldable and height adjustable bench or seat. There should also be a shelf.
- Foldable **support grab rails** must be placed on both sides of the toilet and are also recommended on both sides of the washbasin. Fixed grab rails are necessary in the shower or in proximity of the bath and a pull bar on the inside of the toilet door.

Other important elements are adequate lamps providing **good lighting**. Although natural light and ventilation is not obligatory, it adds value to these hygienic spaces, so it is favourable to design a window there, when possible. If there are no windows, artificial **ventilation** is also necessary. The design should propose visual **contrasts** improving navigation in space and among accessories. **Non-slip** surfaces are crucial, because many accidents can happen in bathrooms due to slippery surfaces.

More detailed information about design solutions is provided in Module 4, Unit 1.

EXERCISE

Find **a floorplan** of an apartment from a development project in your neighbourhood (e. g. from real estate portal) and try to **evaluate** whether it would be theoretically possible to adapt the bathroom to an accessible one.

- Notice whether it is suitably located with adequate **manoeuvring space** in front of the entrance to the bathroom, whether it could be merged with another available space, e. g. with the toilet, closet or store, etc.

Suggest such modifications, also including grab rails and indicate them in the floorplan.

4.5 KITCHEN AND DINING ROOM

IN A NUTSHELL

The kitchen, along with the dining room, is a very important space in the home. It belongs to the main housekeeping parts of the apartment and should be well connected with the entrance area to allow short distances for goods and waste. This space should therefore be welcoming, friendly, well-lit and ventilated, ideally with a connection to an outdoor area, and have dimensions and equipment adapted to be universally accessible to all inhabitants in the household. The kitchen layout and a logical division of zones is essential for a good useability. We consider the concept of the kitchen triangle and several possibilities of shapes (straight line, parallel, L, G, U – shapes or islands).

The kitchen should be ideally oriented to the **northeast or northwest**. Nowadays, the kitchen and the dining room often form not only a space for preparation and consumption of food, storing or washing, but also a **social space** for gathering, visiting, conversations, games or other activities. The reason for this evolution is the merging of duty with fun and an attempt to include the person preparing food in the social scene. The kitchen, the dining room and the living room is nowadays often combined into one common living space, the living area in the apartment. Therefore, the kitchen can be included in such a multipurpose living space as an “open kitchen”. Some information and dimensions presented in this chapter are retrieved from EN 17210:2021 (A: pp. 160–162, B: pp. 110–112), Neufert (2019, pp. 306–317), Daniel et al. (2017, pp. 183–187).

4.5.1 Kitchen layout principles including manoeuvring space for a person in a wheelchair

There are **five basic zones** in modern kitchen layout, each dedicated to a particular task:

- consumable storage zone, storage of food (refrigerator, food cabinet)
- non-consumable storage zone, storage of utensils (dishes, cutlery, slicers, bowls)
- cleaning and waste zone (dishwasher, sink, cleaning supplies, bins)
- food preparation zone (cooktop, stove, microwave, small appliances, cutting boards, spices, etc.)
- cooking and baking zone with pots, baking dishes and pans

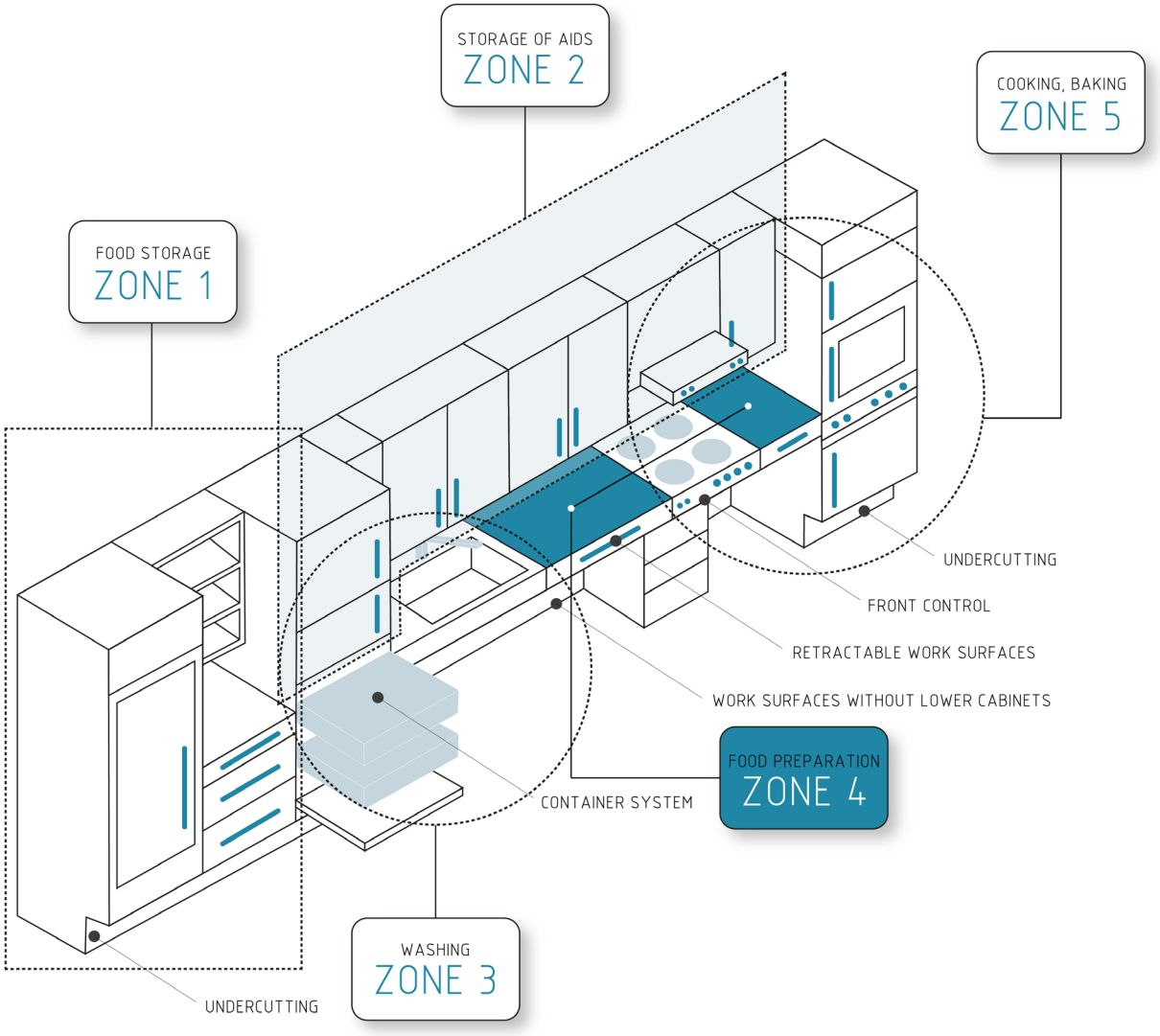


Figure 3.4.23 Zones and their sequence in the kitchen (Rollová, Filová, Suláková)

The size of each zone should accommodate the needs of the household and should be adaptable, able to be partially changed over time. There are often **additional functions** in the kitchen, most often in the form of dining, whether it is a small additional (breakfast) or the main one, but also a zone for making tea/coffee/cocoa, toasts, etc., possibly also a medication zone, a mobile phone charging station, a work or entertainment corner, all according to individual needs and wishes, adjustable over time.

In the first half of the 20th century, people were more dealing with the topic of functional kitchen design and in the 1940s, the concept of **kitchen work triangle** was created at the University of Illinois School of Architecture (Adams, 2018). According to the triangle, three elements: **(1) stove/cooktop, (2) sink, (3) refrigerator/ storage of resources** should be positioned in such a way that they form a triangle (or a line) in this order. The three components arranged clockwise – from left to right are suitable for right-handed people, the counterclockwise arrangement would suit the left-handed. The triangle sides should have lengths ranging from 1,200 mm to 2,700 mm. However, this interval was not calculated with regards to people in wheelchairs, so it is possible to design longer lengths for accessible kitchens if necessary. When considering minimal efficient manoeuvring space to achieve accessibility, floor clearances between all kitchen units or between the units and any wall must be at least 1,500 mm for a regular wheelchair and 1,800 mm for an electric wheelchair to allow turning. The refrigerator door opens in such a way that there is no need to go around the door, which simplifies the transfer of food to the worktop.

Based on the knowledge of the functional areas/zones of the kitchen and the kitchen work triangle, there are several **types of kitchen layouts**. In each case, the length of the free work surface on the counter should be at least 700 mm, each distance between the fridge, sink and cooktop should vary between 900 and 2,700 mm and the sum of all these distances should be in the range between 2,660 and 7,930 mm.

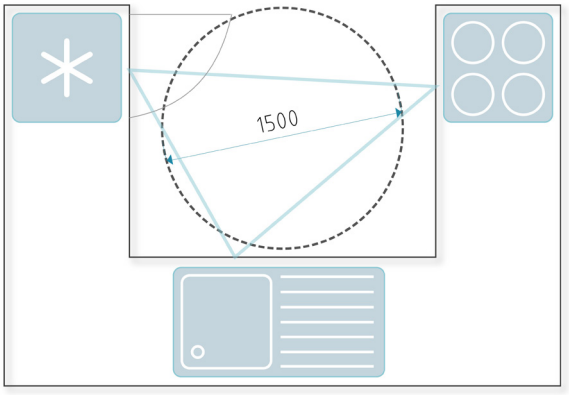


Figure 3.4.24 The kitchen triangle between fridge, cooktop and sink (Filová, Suláková)

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Adam Thomas (2022), accessible kitchen design specialist, recommends a very beneficial solution – to design the **cooktop, stove and sink on the same run of the worktop** to avoid carrying heavy or hot items. It is suitable not only for people in wheelchairs, but also for people with lower physical strength, with a poor grip or other dexterity problems and generally for everyone to avoid potential risks.

- The cooktop should not be at the end of the kitchen counter to ensure enough working area around it. If the cooktop is larger, it increases flexibility.
- A better solution is a separate cooktop and oven, in comparison to a combined stove (cooktop and oven together), because it allows the oven to be placed at a higher height and the cooktop with empty space underneath, so that a person on a wheelchair can slide in.
- The dishwasher should be located next to the sink (left or right side). The layout of kitchens should be designed to minimise travel distance and avoid the need to carry items across the room.

1. **The one-wall/single-wall/single-row/straight** kitchen layout is the simplest solution suitable especially for less generous spaces. It does not implement the classic kitchen triangle, but rather a line, so the disadvantage can be redundant **walking back and forth**. The contact of the cooking person is worse as compared to some of the following solutions, because it is possible only from the **side view or indirectly** from behind the back, which makes the person less involved in the social activities. Moreover, people with hearing impairments need to maintain visual contact with their surroundings, which is hard to achieve using this constellation. Nevertheless, a very important advantage considering accessibility is that, unlike with some other types of layouts, there is less risk of difficult manoeuvring of a person in a wheelchair even in smaller apartments, because the space in front of the single-row kitchen is **usually naturally sufficiently spacious**.

2. **The two-row/double/parallel/corridor** kitchen consists of two separate opposite situated single-row segments. The disadvantage of this type is the **discontinuity** of the kitchen fittings, which can be problematic for people with mobility problems and with less physical strength, thus causing an increased risk of injuries, accidents or dropped food. This is because there is often a need to carry dishes, pots, etc. in the air (e. g. from the cooker to the sink), whereas in most other types of kitchens, items can be moved continuously across the countertop. In general kitchens, a distance between the rows of 1,200 mm is recommended (enough space for two cooks), but for an accessible solution, at least 1,500 mm is necessary (1,800 for electric wheelchair). On the other hand, for people not using a wheelchair, this distance can be slightly too long, requiring redundant movements (max. 1,400 – 1,450 is recommended by Daniel et al.). Thus, this layout type is harder to plan using the universal design. In this case, however, the advantage is the possible **frontal visual contact** with the dining room and the living room, if the kitchen is a part of this space, providing a great benefit for socialisation and people with hearing impairment. Possible follow-up space with serving and seating is also a plus.

3. **The L-shaped** layout is placed along two adjoining walls perpendicular to each other. The corner cabinets are challenging when placing shelves – these are hard to reach. However, it can be solved by installing corner mechanisms such as kitchen carousel or kidney corner unit, which can maximise the space under the corner counter and make it reachable. Another issue to consider is not to have **too long distances** between the ends of the L-shape which can then be ineffective. In case that the sum of the distances should exceed 7,930 mm, Daniel et al. recommend to use the island type. This layout usually does not occupy too much space, so it is also suitable for smaller apartments, and naturally allows enough room for **manoeuvring** in a wheelchair. Another positive feature can be the placement of a dining table or an island in the empty corner of the L. As the L-shape is located along the walls, there is **insufficient visual connection** for the person using the kitchen with the rest of the space, similarly to the straight kitchen type, so it is not very suitable for people with hearing impairment.

4. **The U-shaped** kitchen is composed of a combination of two-row and L-shaped kitchen. This is a spatially demanding type of layout, therefore suitable for bigger apartments. As with the two-row kitchen, there are slightly contradictory needs for various people, because for people using wheelchairs, it is again necessary to have at least 1,500 mm between the opposite segments, whereas for people not using wheelchairs, this can cause **too long distances** and redundant walking or movements. However, it can be advantageous in case of a multi-member household, the spacious solution can be effective when several

people are involved in food preparation at the same time. This layout can also offer **nice views** of the living area, of course if the U-shape is not entirely enclosed by walls. This can be of great advantage for people with hearing impairment who can see into space. Moreover, if the room is exceptionally large, even an island or a table in the centre of the U-shape can be incorporated. It would create a central work/social zone. The potentially problematic corner cabinets are solved similarly to L-shaped kitchens, using corner mechanisms.

5. **The G-shaped/peninsula** layout is quite similar to the U-shaped one, but another perpendicular segment is added to the U, or it can also be similar to the island type, when the island is connected to one wall. A peninsula adds another segment in space in addition, which can have seating in that area and form a nice **social element with views** of the space. This arrangement is suitable for people with hearing impairment. However, the G shape is very **space-demanding** and to be fully accessible, requires a minimum distance of 1,500 mm between the segments to allow a person in a wheelchair to manoeuvre, thus being suitable for larger apartments.

6. **The island** kitchen can be made as a combination of several already mentioned layout types with an island which is not connected to any wall or segments of a row, L or U-shape. It usually requires **generous space**, even more generous to achieve accessibility. As described in the two-row kitchen, the **discontinuity** can cause problems while carrying objects in comparison to continuous counter shapes. The island can create a **social zone with views** and its design can be very good-looking. However, when making a decision, the use of L, U or G-shapes using peninsula instead of an island should be preferred, mainly because of the undoubted advantages of continuous work surface and possibility of creating a social zone at the same time. Alternatively, it can be a good solution to place all the three elements (fridge, sink and cooktop) in one row or in the L or U-shape and to have the island only as a social zone, possibly with occasional dining. This solution eliminates the dangers caused by discontinuity of countertop when preparing meals, and provides social and visual opportunities for people with hearing impairment as well.

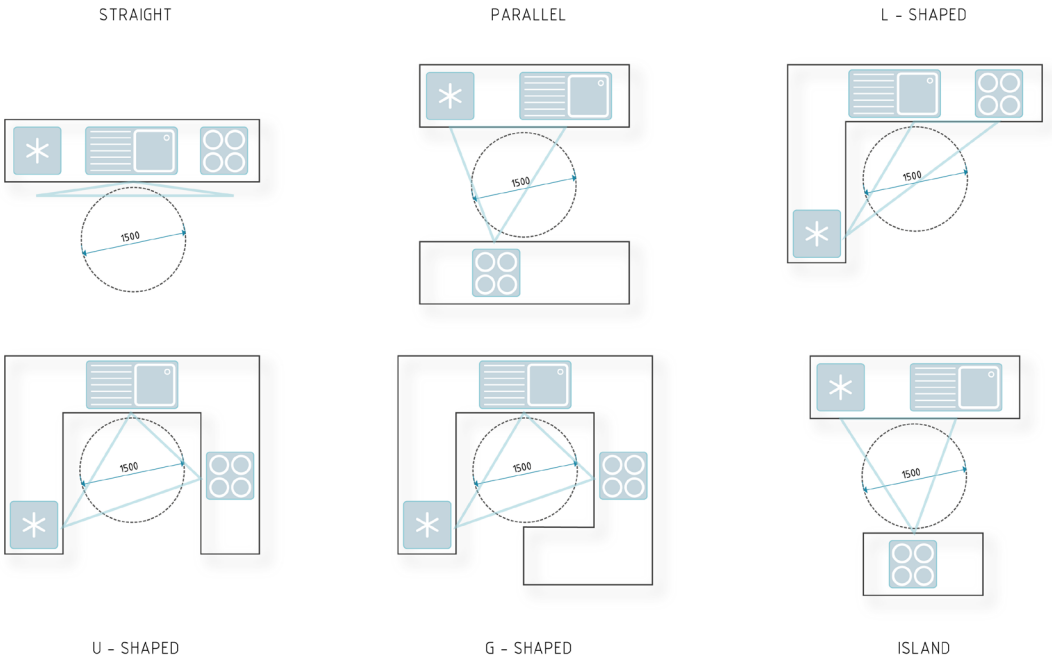

Figure 3.4.25 Layout kitchen types (Filová, Suláková)

4.5.2 Adaptable kitchen solutions

On average, people replace kitchen every 20 years, so we have to think about the **changing conditions** in the home. The requirements and health conditions of users change over time, so the kitchen should be as adaptable and timeless as possible.

There should be, for example, **adjustable and removable components** that will serve even in case of mobility impairment. The key is to choose the right layout shape suitable for the room. Natural accessibility can be achieved using a single-row kitchen unit and the L-shape. The rest of the shapes, the two-row kitchen unit, the U and G-shape or the island are only accessible when positioned to allow 1,500 mm between the fixed elements, which is above standard distances and not optimal for people not using a wheelchair. Therefore, we can consider a U or G-shaped layout installed in a way allowing to remove or move the peninsula part further from the other parts of the kitchen in case of need for manoeuvring space for a wheelchair in the future.

The heights of various kitchen components must also be carefully considered. The countertop, shelves and all storage spaces should be reachable from a seated position. The kitchen countertop should be positioned lower than what is usual, the usual height being between 850 and 920 mm according to Neufert. The exact decision for the height is based on the height of the person using the kitchen the most, but for wheelchair accessibility, it should be a max. of 800 mm high. Also, various heights of the working area are suitable for various activities, for example, Daniel et al. mentions heights for people not using a wheelchair in this way:
(1) the zone for food preparation, cooking, its disposal area should be ideally 800 mm high and (2) washing, working and its disposal area is ideally 900 mm high.

Thus, ideal heights differ for people of different heights, as Gilbreth advised as early as 1930 (Penner, 2022). For various activities and for diverse mobility conditions, we can see that an ideal solution for a multi-member household with different heights and needs (and for various activities) is a countertop with **adjustable height**. It can be operated using a button or lever with power booster, we can also mention voice-activated home assistants and remote controls. When adjustability is not applied, work surfaces and appliances are at two different heights. The sink should always be shallow to enable easy access from a seated position. Darker coloured work surfaces for countertop are preferable as they make it easier to identify lighter objects located on them.

A similar principle is applied to **overhead cabinets**, the height of which should be adjustable, the cabinets ride on wall rails, and there are even pull-down shelves, cabinets that swing out of the wall entirely by means of a lever mechanism to a comfortable height within the reach of a seated person. So, over time, we can consider replacing fixed and high upper wall cabinets with a flexible movable solution, rise-and-fall worktops that allow people to reach all spaces even from a sitting position.

The need for the amount and purpose of **storage spaces** can also be modified over time, thus also cabinets can be designed to be removable to allow enough empty space below the countertop. Alternatively, they can be replaced with cabinets on wheels that can be easily moved while maintaining storage space.

In order for the above options to be functional, it is necessary to have well placed static and hard-to-change elements connected to utility networks, for instance, the sink and heavy

equipment like dishwasher and oven. The dishwasher and the washing machine should be on a plinth, so they are easier to reach for everyone. Waist height is ideal for placing the oven, both for people in wheelchairs and others, because they do not need to bend with the side opening door to prevent leaning over the door.

Kitchen surfaces are also an important issue, they should be **easy to maintain and anti-slip** to ensure hygiene. The application of **colour contrasts** is also important to make the kitchen usable even in the case of partial visual impairment. The floor is an especially important decision. Fortunately, cabinet doors can be replaced relatively easily over time, so that in case the original surfaces deteriorate, or are not contrasting enough or appealing any more, etc., they can be adapted.

4.5.3 Dimensions for installation of kitchen furnishings and equipment

Many basic layout dimensions and their application are explained in more detail in chapter 4.5.1. Kitchen layout principles including manoeuvring space for a person in a wheelchair. Here is a summary and conclusion of the **basic dimensions**:

- All **distances** between opposing pieces of equipment must be **at least 1,500 mm** for a regular wheelchair and **1,800 mm** for an electric wheelchair.
- The work surface – **countertop** must have a free space of **at least 700 mm** long and ideally **height-adjustable**. Otherwise, there should be two heights, the lower work surfaces should have a clear knee space underneath to enable people to sit during food preparation. A suitable work surface for persons in a seated position is between **740 and 800 mm**.
- The minimum **clear height under the countertop** should be **700 mm** to allow the approach of a person using a wheelchair.
- **The distances** between the **fridge, the sink and the cooktop** should vary between **900 and 2,700 mm**. The sum of all these distances should be in the range between 2,660 and 7,930 mm.
- All lower **cabinets** should be approx. **200 mm above floor** with a recess to allow space for feet of the person in a wheelchair.
- **The dishwasher** and the **washing machine** should be on a plinth, also approx. **200 mm from the floor**.
- The wall cabinets should ideally be adjustable, and part of the **shelves** should be at a reachable height of **500/1,100 mm** above the floor surface. Protruding cabinets and shelves should be marked at floor level, e. g. with a stopper or a decoration/house plant, so that they are detectable for people with visual impairment using the white stick technique. They should also have a contrasting colour as the background to help people with residual vision.
- The **oven** should ideally be at **waist height** with a sliding or side opening oven door.
- Electrical **sockets and switched** sockets should be placed on side walls at a maximum height of 150 mm above the work surface.
- **Microwave ovens** are either located on a work surface or mounted so that the base of the oven is at a **max. height of 850 mm** from the floor and its **controls max. 1,150 mm** from the floor.

4.5.4 Dining room layout principles including manoeuvring space for a person in a wheelchair

The dining room is frequently replaced by a dining zone in the kitchen, or in the living area together with the living room and the kitchen in one space. It should be placed in the **south or west** part and well connected with the kitchen to ensure easy transfer of meals. The dining space is a very important area because many social events take place there. The dining room fulfils a communication function, together with the living room it provides a common space for the apartment residents and also guests.

For the dining room or area, it is also essential that the wheelchair user has enough space for manoeuvring, at least on the route to one seat at the table, so the minimum width of 1,500 mm, opt. 1,800 mm is important. The dining area dimensions depend on the number of people at the table and on whether the table is intended to be accessible for a person in a wheelchair from one side only or from several sides. If the dining area should offer one accessible seat, it should be a space of at least 3,000, 2,600 mm or 3,400 × 2,900 mm, depending on the table layout. Two accessible seats are available in case of a dining area with the width of 3,100 mm and all places are accessible when the dining area is at least 4,000 mm wide.

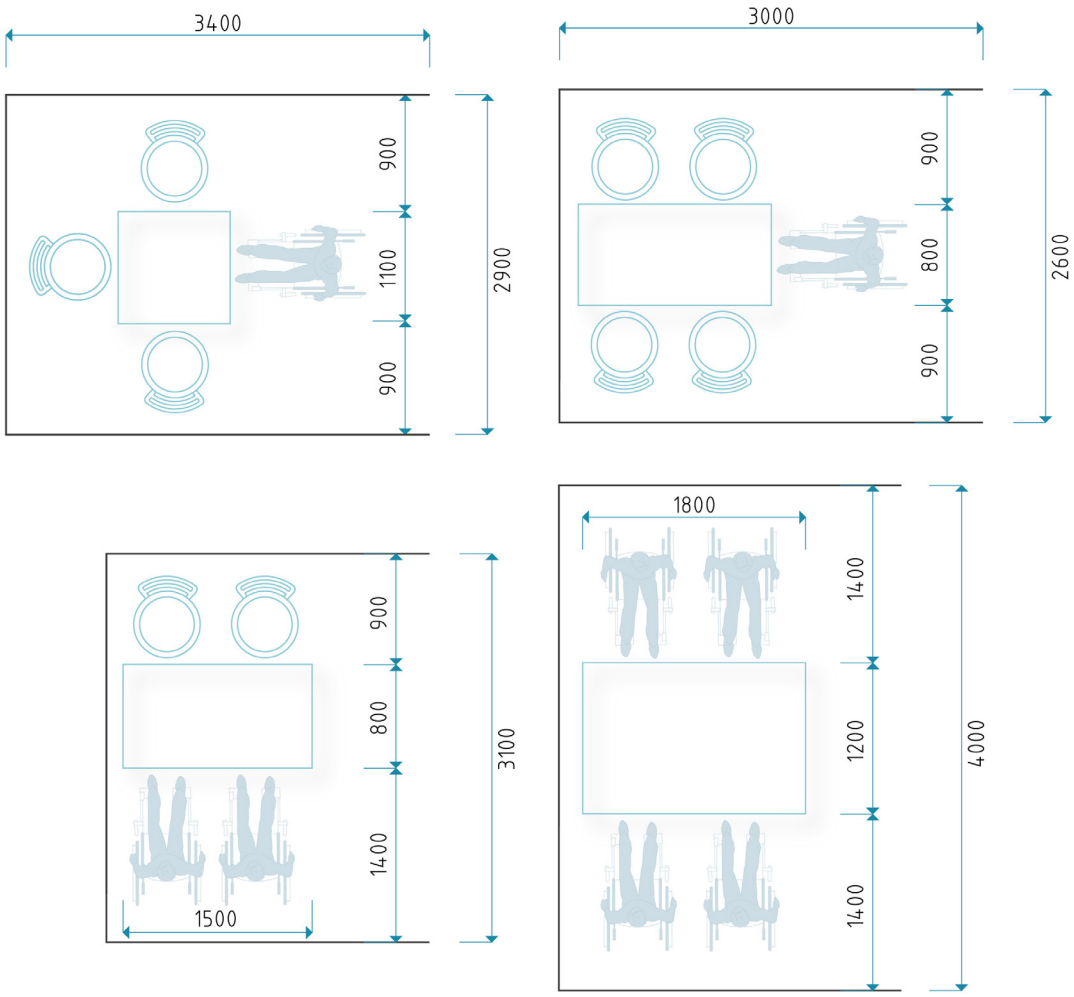

Figure 3.4.26 Schemes of accessible dining area examples (Rollová, Filová, Suláková)

4.5.5 Kitchen cabinets, table, chairs and other furnishings and appliances

When possible, all equipment and furnishings should be **flexible**. **Kitchen cabinets** should be easy to use, with door handles which are easy to grip or touch-operated tip-on systems without handles. Kitchen elements, such as cupboard doors, cupboard door handles and drawer fronts, should contrast visually with the adjacent surfaces so that all are clearly identifiable.

Tables need to have an empty space underneath to be usable by people in wheelchairs. The empty space must be a min. of 900 mm wide and 600 mm deep. Darker coloured surfaces help to identify lighter objects placed on them, such as plates.

Chairs must have backrests and at least some of them should also have armrests, and also seat cushions to provide comfortable seating and getting up for older adults, but also people with back problems or pregnant women.

Also, other furnishings and items need to be ergonomic, contrasting, easy to maintain, etc. More information about the design of these elements can be found in Module 4, Unit 1 and in Module 5, Unit 2.

EXERCISE

Analyse the kitchen in your household:

- **Identify zones in your kitchen**: Consumable storage zone, non-consumable storage zone, cleaning and waste zone, food preparation zone, cooking and baking zone.
  - Are there also other additional zones in your kitchen?
  - Would you suggest any modifications regarding location and dimension of the zones in your kitchen for better functioning?
  - What additional zones would you think about adding for (a) a small child, (b) a teenager, (c) an adult, (d) an older adult.
- **What modifications** would you suggest in your kitchen to make it **accessible** for people in wheelchairs and for those with hearing impairment?

4.6 LIVING ROOM

IN A NUTSHELL

The living room really is a space for everyone and should be inclusive and universally accessible. Adequate manoeuvring space and dimensions must be taken into account.

In this unit, we will analyse solutions for various functions placed in living rooms, such as socialising and hobbies.

Nowadays, the living room is often connected with the **dining room and the kitchen** in one space. The living room should have nice **views to the exterior** and ideally also a physical connection with it using a balcony, terrace, loggia or (winter) garden and oriented to the **sunny** sides, usually in combination with the south side. The living room should not only be a place for the residents of the apartment, but also for visitors; therefore, the **visitability** of the apartment for people with various needs is also very important. Luckily, thanks to the generous space that living rooms should have, it is easier to achieve enough manoeuvring space.

4.6.1 Living room layout principles including manoeuvring space for a person in a wheelchair

The living room should be **spacious**, its narrow side should be at least 4,000 mm wide. The size of the room depends on the functions the living room has to provide, and also on the number of people who will live in the apartment. Usual functions comprise social interactions, watching TV (or other audio-visual media), reading (with a possible home library), playing games or musical instruments, doing other hobbies, etc. As was already mentioned, the living room space is often seamlessly connected with the dining room and kitchen. The open floor plan solution also saturates the needs of people with hearing impairment, who need extra visual connection while communicating or taking care of children.

To enable accessible **manoeuvring** in the living room, like in other spaces, it is necessary to have zones for activities with a min. circle diameter of 1,500 mm, opt. 1,800 mm. Local distances between furniture can have smaller distance in a lesser extent (approx. 900 mm), but only as a short transitional space leading to a place, where the circle for manoeuvring is provided.

Living rooms are often connected with **exterior spaces**. To enable an accessible way to the exterior, balcony doors must be a min. of 800 mm, opt. 900 mm, wide with a door of maximum threshold height of 15 mm. To be able to manipulate the doors, there must be a manoeuvring circle in front of it (not colliding with the path of the door). A space-saving solution is sliding doors.

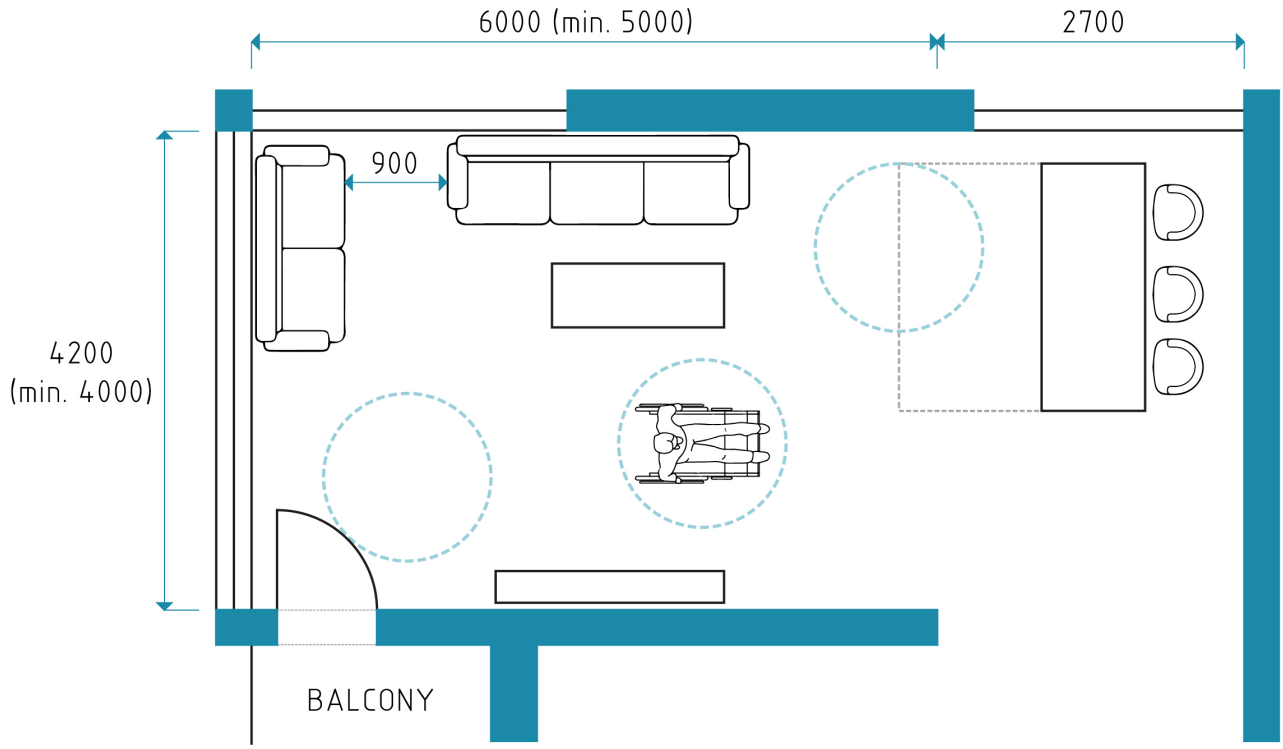

Figure 3.4.27 Illustrative floor plan of an accessible living room (Lacho, Suláková)

4.6.2 Adaptable solutions

Usually, there are few or no built-in interior elements in the living room, most of the furniture is mobile. This solution allows great daily flexibility, and also easier complete replacement of furniture. Easily movable, light and smaller furniture with various possibilities of configuration in the layout is preferable. Unnecessary furniture or decorative pieces should be relocated or entirely avoided, because they cause obstacles and barriers.

When considering floor surfaces, we can also anticipate the need for possible changes, so we can have, for example, a wooden, cork or cast floor and a carpet on top. In the future, when the carpet is too difficult to maintain, we can remove it and have a suitable layer already prepared under it.

4.6.3 Adaptable solutions

Sitting in the living room has become less formal and more relaxed than in the past. Nowadays, mobile solitaire seating sets complemented by serving tables are preferred. These furnishing items allow for **different variations** of set-ups and are more optimal than a compact and heavy seating set-up.

Young people prefer sitting bags and various informal types of seating, where ergonomics and multi-functionality play a big role. Older adults need other, more stable types of seating furniture, with higher lever for sitting, optimal height being 500 mm, to facilitate standing, often with adjustable back and arm rests.

More information about seating furniture possibilities can be found in Module 4, Unit 1 and Module 5, Unit 2.

4.6.4 Dining space (in the living room)

In modern layout solutions, the dining room is very often integrated into the living room. It is a nice way to connect people in the household in one space and enjoy shared time and space. This solution is especially beneficial for people with hearing impairment, who can see what is happening in all these spaces and, for example, watch over the children playing in the living room while eating. The dining room, which is part of the living room, should be located to the **south**, possibly also to the west facade.

In addition to eating, the dining area provides opportunities for social life, communication, meeting guests, but also for doing homework, etc.

As mentioned several times, the space for manoeuvring is very important to achieve accessibility, therefore the minimum circle of 1,500 mm, opt. 1,800 mm, must be in front or next to a place for seating at the dining table.

4.6.5 Working space (in the living room or separate)

The workspace usually consists of a work table/desk and a chair.

- A key condition for an inclusive workspace is the provision of manoeuvring space in front of the work desk of a minimum circle of 1,500 mm, opt. 1,800 mm.
- Another important issue is the possibility of tucking in under the table, so the empty space must be a min. of 900 mm wide and a min. of 600 mm deep.
- The height of the table should ideally be adjustable; otherwise, it should be approx. 700 mm.
- We can also think about the inclination of the desk; for writing, the inclination is 10 – 15°, for reading it is 25 – 30°.
- The colour of the table surface should be dark, so that lighter objects placed on the table can be easily identified.
- As for the chair, it should be ergonomic, with back and arm rests and be adjustable.

4.6.6 Other furnishings

Similar to kitchens, there are often **shelves and cabinets** in the living room. They should be approachable and reachable for people in wheelchairs, so that the preferred height to place them is **500 – 1,100 mm above the floor surface**.

Piece rugs/carpets can create difficulties for a person using a wheelchair, in addition to posing a risk of stumbling. A better solution is therefore **full-surface floor finishes**. Carpets can create a warm and acoustically comfortable environment, which can be pleasant for older people. However, carpets are more difficult to maintain in a hygienic standard, they can be a source of dust and allergens. Therefore, the designer should consider all the advantages and disadvantages and find optimal solutions for individual people in cooperation with the client. Cork is also a consideration for being soft and warm natural material, but also wood or cast floor, while attention must be always paid to **anti-slip** properties of the materials.

4.6.7 Daylight and thermal comfort

Concerning the daylight, we should firstly design the living room in a good position, so that it faces **sunny cardinal points**. Combinations with the south are suitable, possibly also with the west, as people usually spend most of the time in the living room during afternoons.

In this regard, we should also think about nice views. To enable views also for people in a standing or lying position, the **window sill** must be lowered to a maximum height of **600 – 700 mm**. French windows without a window sill are optimal, of course with railings if an apartment is on an elevated floor. To provide a nice view, glass railings or railings made of other subtle material are suitable. The area of the window to the area of the room should be at least 1:8, optimally more.

When choosing windows, we also consider their energy performance; there are glasses that capture up to 70 % of heat radiation while maintaining 80 % transparency (Pifko, Špaček et al., 2008., p. 138).

To ensure the possibility to set the desired level of daylight, architects and designers must also think about shading. **Shades** can be installed in the interior or exterior, or both. There are several types, such as sliding sunshades, blinds, roller blinds or curtains. Shades can also prevent the penetration of unwanted sunlight into the interior. When considering a thermal point of view, exterior shades are preferred for already blocking the sun rays outside, so as the windows do not overheat and the interior gets less warm.

DO YOU WANT TO KNOW MORE ABOUT...

To support naturally **optimal thermal comfort**, the Socrates House principle is applied (Dumitracu et al., 2018). This principle says that the living rooms face the south, when the building is in the northern hemisphere. (It would be north when designing in the southern hemisphere.) To ensure the desired thermal conditions, there is a cantilever overlay above the south windows, which ensures that

(1) in the summer, when the sun shines from a higher incidence, the overlay blocks the sun rays from entering the interior, thus preventing overheating,

(2) in the winter, the sun angle is closer to the horizon, so as the rays enter the room and warm it.

If this basic principle is followed, thermal comfort is naturally easier to achieve and finances for air conditioning and heating are saved. The principle does not work when the position relative to cardinal points is different, e. g. when the windows face the east or the west. In those cases, we need to prevent the sun rays from entering the interior using preferably exterior shades.

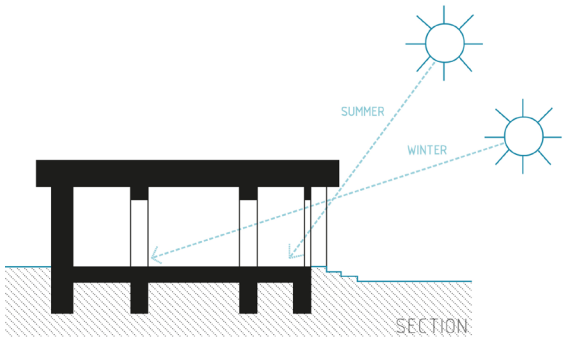

Figure 3.4.28 Principle of the Socrates House (Filová, Suláková)

Of course, it is also necessary to implement artificial ways of ensuring thermal comfort. For example, installing **air conditioners** to prevent overheating during the hottest days.

Heating systems are definitely a necessity, and we can think of multiple techniques which also reflect ecological and economic conditions (various types of boilers, heat recovery systems, pumps, etc.). Floor heating is the most comfortable solution, because it provides pleasant radiant warmth from the feet and prevents the need for radiators that could obstruct manoeuvring. A fireplace can also be a pleasant and aesthetic secondary source of heat. Of course, it is important to take safety into account when using it.

EXERCISE

See a current **catalogue of furniture** and try to choose pieces you would use in design of **an accessible living room** with a seating area, dining area and working space.

- You can also choose an additional space for a hobby according to your preferences.

Consider shapes of the furniture (not dangerous, to be able to tuck in, reachable, with supporting elements like armrests, etc.), but also contrasting colours and aesthetic appeal.

4.7 BEDROOM

IN A NUTSHELL

Bedrooms are the most private, individual and intimate rooms in the apartment and are essential for physical and psychological health of people. Quality sleep, relax and intimacy is a very important part of life. Therefore, the bedroom design must be deeply-thought and discussed with future users. Accessibility, safety, comfort and calmness are key determinants of a suitable bedroom solution.

Bedrooms are designated for apartment's residents and visitors usually do not enter these rooms, with the exception of children and students who often invite friends to their room. The bedroom includes many **important functions** such as sleeping, resting, intimate life, taking care of oneself and small children, but also storage space mainly for clothes and bed linen. Sometimes, there can also be a work desk. One bedroom should be intended **for a max. of two people** (except parents with a small child).

4.7.1 Bedroom layout principles including manoeuvring space for a person in a wheelchair

The good position of bedrooms in a layout is the one when **separated from the social zones** (kitchen, dining room, living room) and when visitors should not need to go to the private areas (e. g. to go to the toilet). Each bedroom should have its own entrance from a common space, hall or corridor. Transition rooms are no longer applicable nowadays.

Ideally, bedrooms face the **east**, south-east, north-east, so that there are sun rays in the morning. In the case of bedrooms for children, optimal combinations are with the south, south-east, but also combinations with west can be beneficial, because children spend their time in the room mostly during afternoons, so they can enjoy afternoon sun rays.

The bedroom area for two adults is at least 14 m^2, opt. 16 m^2. For one adult person or a child, it is a minimum of 10m2; for two children, it starts from 12 m^2. To enable manoeuvring space, it is important to place bed(s), wardrobes or tables in such a way that in front or next to these pieces of furniture, there is a circle with a minimum diameter of 1,500 mm, opt. 1,800 mm. The route from the room entrance to the bed should be simple, ideally straightforward.

Preferably, the bedroom and the accessible **bathroom** with toilet should be **adjacent**. It is a recommended solution especially for the elderly due to their hygiene requirements and limited movement and orientation. This arrangement is also suitable for retrofitting a ceiling lifting device to move from the bed to the bathroom.

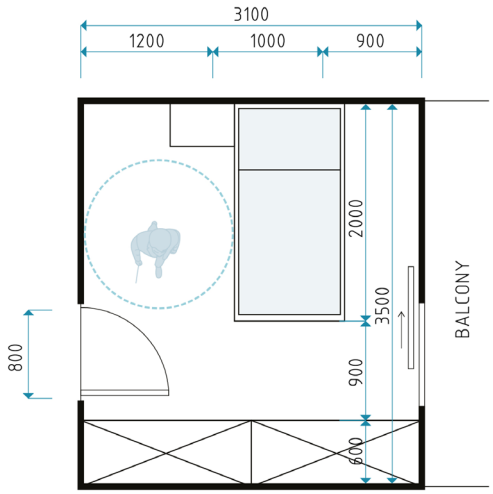

Figure 3.4.29 Illustrative floor plan of an accessible bedroom with a single bed (Lacho, Suláková)

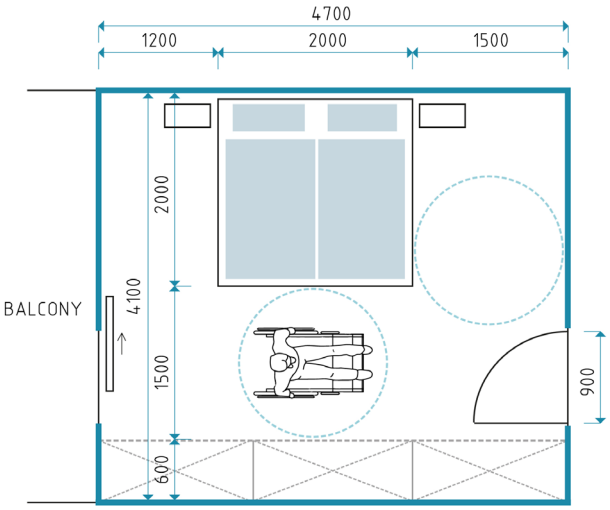

Figure 3.4.30 Illustrative floor plan of an accessible bedroom with a double bed (Lacho, Suláková)

4.7.2 Adaptable solutions

The bedroom should be adaptable, because as adult people and also children grow older, their needs and preferences evolve and change. At one time, the bedroom can be a room for a child who needs a small bed and plenty of space to play, then a room for a teenager who needs a big bed and space for studies. Later, it can be a bedroom for a couple with a small child needing a crib, then it can be a bedroom for an older couple or a single person. An adaptable solution can be, for example, swapping of various pieces of furniture, e. g. a baby crib for a dressing table, and, if necessary, free up this space completely for comfortable manoeuvring and installing grab rails.

The room should be subsequently **easily furnished and modified**. Therefore, easily changeable mobile furniture is generally a good solution. Of course, built-in elements are also practical, because they save space and provide a complete look tailored to the room. In the case of designing built-in furniture, care must be taken to ensure that it is designed correctly, timelessly and with good access, because it would be difficult and expensive to change it. However, these elements can also be adapted, for example a wardrobe with sliding doors that can be changed or removed quite easily.

4.7.3 Bed

The bed must be placed in the bedroom in such a way that the accessible entrance side of the bed must be at least 1,500 mm, optimally 1,800 mm from the wall. Of course, if the room is larger, the bed should be accessible even from both sides. If it is a double bed, it would be accessible for both partners, or a person in a wheelchair could choose the optimal side.

The bed is a **key piece of furniture**, because it largely determines the quality of sleep, which is a very important part of everyone's life. It should be comfortable, hygienic, with a nice, relaxing design and colour solution. Its optimal **height** for older adults is higher than the standard **approx. 500 mm**. The bed can be portable on wheels and adjustable, positionable. Such types of beds are usually slightly larger than regular beds and are made in different designs, they can look homely and cosy, not hospital-like.

More information about the bed and matrasses can be found in Module 4, Unit 1.

4.7.4 Wardrobes

Accessible wardrobes are easier to use when they do not have doors or they have only an easy-to-operate closing system. They should have lower storage spaces, so that they are **reachable** by a sitting person at a maximum height of 1,200 mm. It is also possible to use the entire height of the cabinet up to the ceiling, if a pantograph system is used.

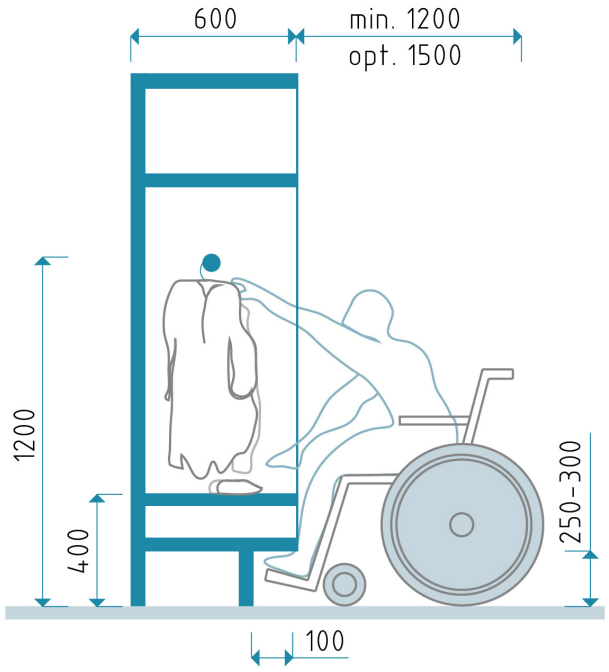

Figure 3.4.31 Reachable heights for storing for a sitting person/a person in wheelchair (Rollová, Suláková)

4.7.5 Other furnishings

There can also be other furnishings in the bedroom. For example, **bedside tables**, sometimes a **dressing table** or a **work desk**, carpet or rug, etc. can be mentioned. Very good solutions are low cabinets and commodes with drawers, which are, however, quite space-demanding and these must not interfere with manoeuvring. Each of the furniture pieces must not obstruct the route and pose possible risks of injury. Sleepy people and older adults especially can get dizzy, so the furniture must be designed and placed in a way to **prevent the risk of injuries**. For example, we could prefer rounded corners, soft materials in the parts, where one could easily bump into, but we should also avoid placing rugs or smaller carpets in the bedroom, that could curl, slip or snap, causing a person to trip and fall.

Grab rails can provide support for people not only in bathrooms, but also in other rooms such as bedrooms. They would be especially suitable on the way from the bed to the door. The same applies to the emergency pull cord switch or button which can be placed in the bedroom, so that a person who has fallen from the bed to the ground can call for help.

Ceiling lift is a helpful aid for transferring people with significant mobility limitations. It can be installed on the ceiling, providing transfer from the bed to the bathroom, living room, or any other desired part of the apartment. The system can also overcome door lintels.

4.7.6 Daylight and thermal comfort

Just as the living room, the bedroom also needs **sufficient daylight and thermal comfort**. Moreover, the need to regulate the amount of light is higher to meet the conditions for an undisturbed sleep even during the day.

The bedroom requires a slightly lower temperature than other rooms to support a good sleep. However, older adults often prefer higher temperatures than younger people, so an ideal solution to meet everyone's needs is to have the thermoregulation of each room separately.

EXERCISE

Ask 3 – 5 people of various ages in your neighbourhood what three features of a bedroom are the most important to them and compare the results.

SUMMARY

An **adaptable apartment** does not have to be fully accessible from the start of use, but must allow for the selection of accessible elements or accessories that can be modified or added if necessary to better meet the various specific access requirements of users.

The adaptability of the apartment layout can be ensured by **removable walls**, in which no installations (electrical cables or water pipes) are built. Thanks to the removable walls, the number or size of the rooms can be adjusted depending on the needs of the family.

The living area of the apartment has the character of an **open layout**, which provides enough space for a variable arrangement of furniture, and the kitchen corner has such a large floor area that it is possible to manoeuvre even for people in a wheelchair.

The greatest demands must be placed on a **good bathroom design**, so that it can be easily adapted to the needs of the household. An integral part of hygienic spaces (bathrooms and toilets) is a floor drain, so that it is possible to shower next to the bath or toilet, if necessary. The accessible bathroom is a key space in age-friendly housings. Entrance to the bathroom should allow comfortable manoeuvring in front of the door, the door must be wide enough and opened outwards or sliding. There are several layout possibilities, two basic types are with a toilet situated in the corner and both side solution (peninsula). There are also accessible bathrooms using a shower or a bathtub, or both. There is a possibility to design an **adaptable solution**, so that it is possible to easily create an accessible bathroom in an apartment in the future. Dimensions for positioning individual furnishings have a great importance and effect on the functionality and usability of a bathroom, as well as its design, e. g. surfaces with **visual contrast** and **anti-slippery** properties.

Multiple **kitchen** layouts offer different positive and risky features. When designing a smaller kitchen, we should consider the single-row unit and the L-shape which naturally offer enough

space for manoeuvring with a wheelchair. On the other hand, when there is enough space, the U and G-shape can be designed, because they allow continuous working sequence. Two-row/parallel units and the island kitchen are less suitable to be designed as accessible. The key rule is to have a functional kitchen work triangle with (1) stove/cooktop, (2) sink, (3) refrigerator/storage in this order for right-handed people and the opposite one for the left-handed. To achieve accessibility, we always must have at least 1,500 mm, opt. 1,800 mm between fixed elements of the kitchen to allow manoeuvring. The size and function of the five kitchen zones can be adapted over time, for example by mounting/dismounting the upper cabinets, by fitting a larger or smaller number of lower cabinets which are ideally flexible, movable on wheels. Preferably, the countertop is also flexible and can be positioned in various heights.

The **living room** should be an **inclusive space** for all inhabitants of the apartment, and also for possible guests. Many diverse activities happen in the living room such as relaxing, communicating, playing, but also learning and dining in case the dining area is a part of the living room. Daylight, thermal comfort and views to the exterior are crucial factors of the living room which determine the quality of the space. People of various ages often spend a long time there, and to be able to enjoy it fully, the living room should be also well equipped. The furniture should be flexible, propose various types of seating and ergonomic with enough manoeuvring space.

Bedrooms are very important and **private** rooms of an apartment. They should serve their inhabitants optimally, and therefore be accessible and safe especially for people with special needs and older adults according to their individual requirements. There are several elements which can help achieve accessibility and safety, such as enough manoeuvring space, straight easy route to the bed, near distance to the bathroom, grab rails, ceiling lift and assistive device for calling for help. The right choice for bed and wardrobes is essential to create a functional environment, while being pleasant, cosy and relaxing.

REFERENCES

Adams, C. (2018). What is the kitchen triangle? ThoughCo. Retrieved from https://www.thoughtco.com/kitchen-work-triangle-1206604

Čerešňová, Z. (ed.) (2018). Inclusive Higher Education. 1st ed. Prague: Gasset. Retrieved from https://www.stuba.sk/buxus/docs/stu/pracoviska/rektorat/odd_vzdelavania/UNIALL/UNIALL_O6_Inclusive_higher_education_final_elektronicka.pdf

Daniel, P., Hronský, M., Husárová, S., Jelenčík, B., Kočlík, D., Kotradyová, V., Kučerová, M. et al. (2017). Interiérový dizajn. [Interior design.] (1st ed.). Bratislava: Slovenská technická univerzita v Bratislave.

Dumitracu, A. I., Hapurne, T. M., Bliuc, I., Corduban, C. G., Nica, R. M. (2018). Waffle structure optimization in terms of energy efficiency and spatial geometry for a single family house. [Paper presentation]. IOP Conf. Series: Materials Science and Engineering 444 (2018) 082013 doi:10.1088/1757-899X/444/8/082013

EN 17210:2021 (2021). Accessibility and usability of the built environment. Functional requirements (1st ed.). Joint Technical Committee CEN-CENELEC.

FprCEN/TR 17621:2021 (2021). Accessibility and usability of the built environment – Technical performance criteria and specifications (1st ed.). Joint Technical Committee CEN-CENELEC.

Penner, B. (2022). Lillian Moller Gilbreth (1878-1972). The Architectural Review. Retrieved from https://www.architectural-review.com/essays/reputations/lillian-moller-gilbreth-1878-1972

Mace, R. L., Hardie, G. J., Place, J. P. (1991). Accessible Environments. Toward Universal Design. In: Preiser, W. F. E. et al. (eds.): Design Intervention. Toward a More Humane Architecture. New York: Van Nostrand Reinhold, 1991, ISBN: 0-442-27333-9, pp. 155-175, p. 161

Meyer-Meierling, P. et al. (2004). Behindertengerechtes Bauen – Vollzugsprobleme im Planungsprozess. [Accessible construction – implementation problems in the planning process.] Abstract. Zürich: ETH Hőnggerberg, p. 8, 2004

Neufert, E. (2019). Architects' Data (5th ed.). Cornwall: John Wiley.

Pifko, H., Špaček, R. et al. (2008). Efektívne bývanie. [Efficient housing.] (1st ed.). Bratislava: Eurostav.

Rollová, L., Čerešňová, Z. (2015). Univerzálne navrhovanie objektov komunitných sociálnych služieb. [Universal design of facilities for community social services.] (1st ed.). Implementačná agentúra Ministerstva práce, sociálnych vecí a rodiny Slovenskej republiky. Retrieved from https://www.ia.gov.sk/data/files/np_di/publikacie/Univerzalne_navrhovanie_objektov_komunitnych_socialnych_sluzieb.pdf

Samová, M. et al. (2008). Tvorba bezbariérového prostredia. Princípy a súvislosti. [Creating a barrier-free environment. Principles and contexts.] (1st ed.). Bratislava: Eurostav.

Thomas, A. (2022). Thomas Consultancy. Design Matters. Retrieved from https://www.adamthomasconsultancy.com/

Centre for Excellence in Universal Design (2017). Building for Everyone: A Universal Design Approach – Booklet 2: Entrances and Horizontal Circulation. Dublin: National Disability Authority Ireland, 2017, pp. 11-66

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