TOWARDS AN INCLUSIVE LEARNING ENVIRONMENT FOR STUDENTS WITH DISABILITIES

DEVELOPING ARCHITECTURAL DESIGN GUIDELINES FOR ACCESSIBLE EDUCATIONAL FACILITIES

LIGHT FOR THE WORLD - NETHERLANDS

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ACCESSIBLE EDUCATIONAL FACILITIES

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CHAPTER 1: INTRODUCTION

This document aims to establish a set of principles that can be reviewed and considered by educational institutions and schools in South-Sudan, that help to develop an educational environment to meet the needs of students with disabilities. The design principles should be considered in both new and existing educational facilities in this country.

This document not only focuses on creating a barrier-free building (physical and sensory aspects), but also provides planning and design principles which maximize the overall performance of the building environment as a student-friendly learning environment.

Students with different disabilities experience their surroundings different. Therefore, this document also aims to set out a guidance on planning and designing an environment that is more convenient and pleasant for such students. Even though the focus of these principles are on students with disabilities, the approaches outlined in the guidelines are valuable for all students. Designing principles of environments should consider integrating all sensory elements such as visual, auditory and tactile to increase the added value of the building for every user.

Such an integration is strongly recommended in the early stages of designing a new building, as adaptation is always more difficult and costly.

1.1 SCOPE

An inclusive learning environment sets out design and planning guidances for the construction of new, or existing, mainstream educational facilities for various kind of disabilities. These include but are not limited to physical, sensory and/or cognitive impairments.

It considers students of different age, divided into two groups of students: those under 12 years of age and adult students (above 12 years of age). This division is due to differences in anthropometric measurements and the relation of students with the environment (ergonomic factors).

However, educational facility settings may vary widely. Therefore, special attention is required for designing an environment that suits the particular needs of a specific project. The exact requirements of building projects will depend on the educational facility's, the school's particular arrangements and the size and needs of its users.

1.2 TARGET AUDIENCE

This document should be used as a starting point for any requirement statement for a new building, used in close consultation with the future users. It should also be used constantly as a check list to control the design of a building from the early stage of the building process till the execution and operational stage.

1.3 OUTLINE OF THE DOCUMENT

This document is structured such that each chapter discusses a main design guideline.

Chapter 2 starts with general planning and design principles for educational facilities in South-Sudan. It focuses on essential principles for developing an inclusive learning environment that enhances the educational experience for all students, including those with disabilities. This chapter continues with providing recommendations for planning building layouts with logical spatial arrangements that support the functionality of the building for students.

In Chapter 3, the designing guidelines and requirements with respect to access to the building, including the approach routes, parking lots, external level changes and building entrance are discussed. The focus of this chapter is on providing access routes and circulation which avoid confusion in wayfinding, facilitate movement of students and minimize travel distance particularly for students with disabilities.

Chapter 4 addresses the detailed (inclusive) requirements for accommodations within the buildings. It covers the reception and entrance hall, horizontal circulation, internal level change, sanitary facilities and building elements such as doors and windows.

The next chapter, Chapter 5, provides design recommendations for the functional program and required learning spaces. Substantially, it discusses the requirements related to furniture and room layouts suitable for an educational and learning environment.

Finally, Chapter 6 integrates all sensory elements such as visual, auditory and tactile into the designing process and emphasizes on sensory awareness and environmental well-being of the inclusive learning environment. It covers the design guidelines for lighting, acoustics, thermal comfort and ventilation and sensory wayfinding (including signs, color and tactile marking) for an inclusive learning environment.

GENERAL PLANNING AND DESIGN PRINCIPLES 2

INCLUSIVE DESIGN PRINCIPLES

SITE DEVELOPMENT
ACCESSIBILITY
SENSORY AWARENESS
COMMUNITY INVOLVEMENT
HEALTH AND PRODUCTIVITY
FLEXIBILITY
SUSTAINABILITY

BUILDING LAYOUT

CHAPTER 2: GENERAL PLANNING AND DESIGN PRINCIPLES

The general planning and design principles for an inclusive learning environment in South-Sudan is developed for the purpose of supporting students with different disabilities to attend educational institutions and guarantee their rights for equal educational opportunities. It ensures that educational buildings can enhance the proper environment to facilitate and support the education of students with disabilities, together with their co-students without disabilities, in the same classrooms. Furthermore, this chapter provides recommendations for suitable spatial arrangements (layout) of an inclusive learning environment.

2.1 INCLUSIVE DESIGN PRINCIPLES

The inclusive design principles that are considered in this documents focus on site development, accessibility, sensory awareness, community involvement, health and productivity, flexibility and lastly sustainability. This section discusses these key principles separately.

2.1.1 Creating a student-friendly environment

A well-designed and student-friendly environment enhances the learning experience for all students, including those with disabilities.

The exterior appearance of the building should be attractive and create a sense of pride and ownership for students, staff and community as well as proving a welcoming and comforting feeling for studying, working and visiting.

The interior design of the building should create a collaborative environment which enhances the learning process and stimulates the interaction between students and teachers. Creating open multi-functional social spaces, accessible teaching/learning spaces with well organized furniture, fittings and equipment that support a range of learning and teaching styles and finally use of appropriate colors, should be considered in designing the interior spaces.

2.1.2 Site development

Educational buildings must be conveniently located, with good infrastructural links and in proximity to other local and community facilities in the neighborhood. This makes it easier for students with disabilities to access work locations and training opportunities in the vicinity, as well as to enhance the opportunities of social inclusion and local community involvement.

Within the building territory, minimizing the travel distance between different places should be considered. This is very important to provide a reasonable travel distance for students with disabilities. Therefore, the spatial arrangement of the school should be in such a way that place specific functions such as food services, restrooms and elevators, are at central locations and never at the far ends of the building.

2.2.3 Accessibility

Accessibility is a key aspect to aid students with disabilities to take part in educational activities alongside their peers. Design of an accessible environment should consider:

- a minimum travel distance to the building and within the building (see subsection 2.1.2 for *site development*);
- a logical layout which is easily understood by all users;
- a barrier-free circulation route which are broad enough for students using mobility aids such as wheelchairs or sticks;
- ergonomic factors in designing furniture and details such as door handles and handrails such that everyone can use them.

2.1.4 Sensory awareness

A person with sensory impairments, experiences the surroundings very different. Designers should consider the impact of environment on students' sensory experience. It is crucial to take into account aspects such as lighting quality , acoustic and using visual contrast and texture for sensory wayfinding thereby creating a calming space for learning for students with sensory impairments. (See Chapter 6)

2.1.5 Community involvement

The building should provide spaces to facilitate community and parental involvement at the educational activities of the students. For instance, a school environment can not only act as a place for students to learn but also as a community center for the neighborhood. It should be a place to share ideas, interact and enhance the community involvement.

2.1.6 Health and productivity

A built environment should enhance the health and productivity of the students by optimizing indoor air quality and increasing thermal comfort, natural ventilation and decreasing the disturbance from sudden or background noise. Close attention to these factors is mandatory as the poor quality of each of the aforementioned factors can affect the learning process of students, especially students with different disabilities.

2.1.7 Flexibility

In planning and designing of the building, the future growth of the educational facility should be considered. Therefore, the site and the building should be flexible to be able to adopt to the future growth of educational activities.

This can be achieved by:
- providing structural and technical flexibility to allow future adaptation and expansion of the building;
- designing different sizes of space (bigger and smaller ones) to accommodate different types of activities;
- being able to adjust the bigger spaces by using for example movable partitioning to allow the use of space for a variety of learning needs;
- avoiding to create a very specialist spaces that can serve limited activities;
- allowing the re-arrangement of the room layouts by minimizing fixed furniture, fittings and equipment.

2.1.8 Sustainability

An inclusive learning environment should address social, economical and environmental sustainability principles as a whole.

Social sustainability can be achieved by designing a fully accessible and inclusive educational community which has a close relationship with a wider society (e.g. community involvement).

Economical sustainability considers the total life cycle cost and benefits of the built environment, including integrating the cost of inclusive design measures in the plan.

Environmental sustainability take into account the minimum negative impact on the planet and non renewable recourses. An ecological design based on the sub-humid climate in South Sudan[1], use of durable and non-toxic building local based materials, upgrading the exiting buildings for energy efficiency and water efficiency are some of the aspects that should be considered in design.

2.2 BUILDING LAYOUT

Design building layouts with logical spatial organization provide an educational environment which function well for all students including the one with disabilities. This can have an impact on accessibility as well as psychological effect of the surrounding that can influence the behavior of students, particularly students with sensory impairments.

It is recommended to design the layout of the building in orthogonal structures to aid students to orient themselves inside and outside of the building. The layout should be organized in a way that minimizes the travel distances between spaces, especially for students who have difficulty moving independently.

The spaces in the building should cluster together according to similarity of their function. For example, in the building layout can make a distinction between quite and crowded zones, between teaching/learning spaces and spaces used by the community as is designed to enhance social interaction.

Administrative offices and reception should be close to the main entrance as well as spaces that are mostly used by visiting staff and parents (such as meeting/parents rooms).

Sanitary facilities should be (in small clusters) evenly distributed in the building to limit travel distances. (See § 4.4)

Larger multi-functional spaces should be located centrally and be surrounded by smaller classrooms to allowing them to be combined when a larger space is required.

Outdoor spaces should be easily reached, particularly by younger students to enhance the opportunities for outdoor social and learning activities.

When the educational facility should organize classes for various phases of education (students in different ages), the layout should be designed to assign separate part of the building for each phase of education (a progression of spaces from youngest to oldest students) with their own facilities (e.g. sanitary services, external space, etc.). However, some facilities can be located centrally to be shared with all levels such as staff offices, medical room and community related areas (e.g. meeting rooms for parents).

Figure 2.1 shows spatial arrangement and typical area relationships suitable for an educational facility including students in different ages.

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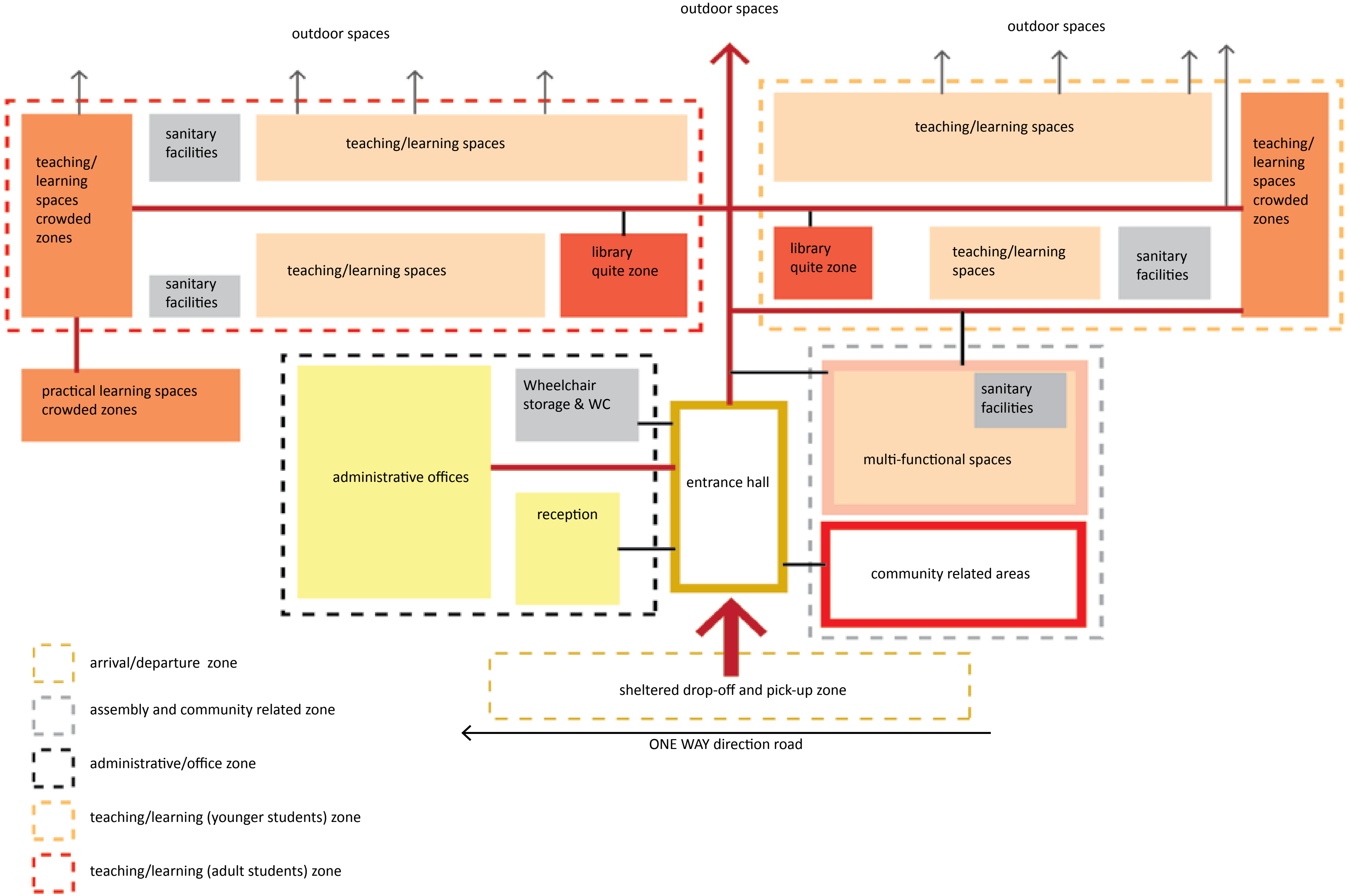
1 Special attention is required for the different regions within the country. According to *Geography of South Sudan*, by Amanda Briney, 2014 (http://geography.about.com/od/sudanmaps/a/south-sudan-geography.htm), the climate varies in the different regions in the country. However, South Sudan has mainly a tropical climate.

Figure 2.1: spatial diagram and recommended building layout for educational facilities



ACCESS TO EDUCATIONAL BUILDINGS 3

APPROACH ROUTES

VEHICLE ROUTES
PARKING LOTS
PEDESTRIAN ROUTES

EXTERNAL LEVEL CHANGE

EXTERIOR RAMPS
EXTERIOR STEPPED ROUTES
HANDRAILS

BUILDING ENTRANCE

CHAPTER 3: ACCESS TO EDUCATIONAL BUILDINGS

For students with disabilities, who are practicing to develop their skills independently, navigation and way finding are a learning process that benefits from careful design and planning. The aim of this chapter is to provide design guidelines for accessing routes and circulation which avoid confusion in wayfinding, facilitate movement of students to the building and minimize travel distance, particularly for students with disabilities.

3.1 APPROACH ROUTES

3.1.1 Vehicle routes

The approach routes to the building should be designed such that congestion of vehicular circulation (public/private transport) is avoided. This can be planned in the form of a roundabout or a one way traffic flow to the drop-off point. (See Figure 2.1 in § 2.2)

The emergency accesses should be planned such that it is not in conflict with the normal traffic flow.

3.1.2 Parking lots

The disabled parking provision should be clearly signposted and visible when approaching the building (Figure 3.1).

The parking space should be wide and long enough to allow the fully maneuver of the wheelchair users (Figure 3.2).

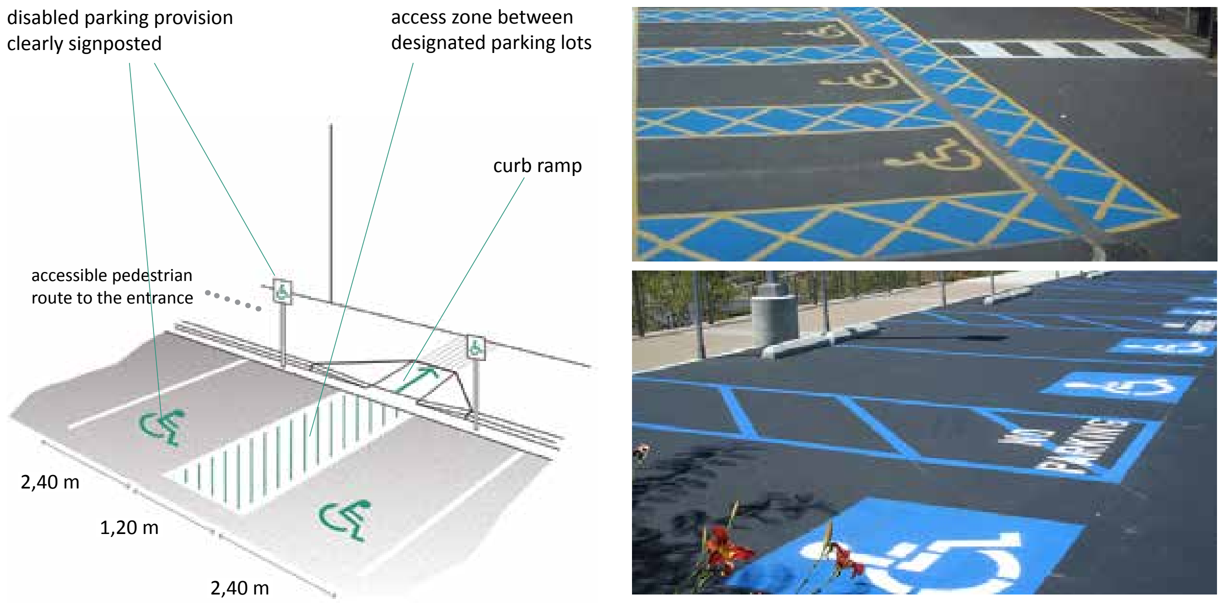


Figure 3.1: well signposted disabled parking provision

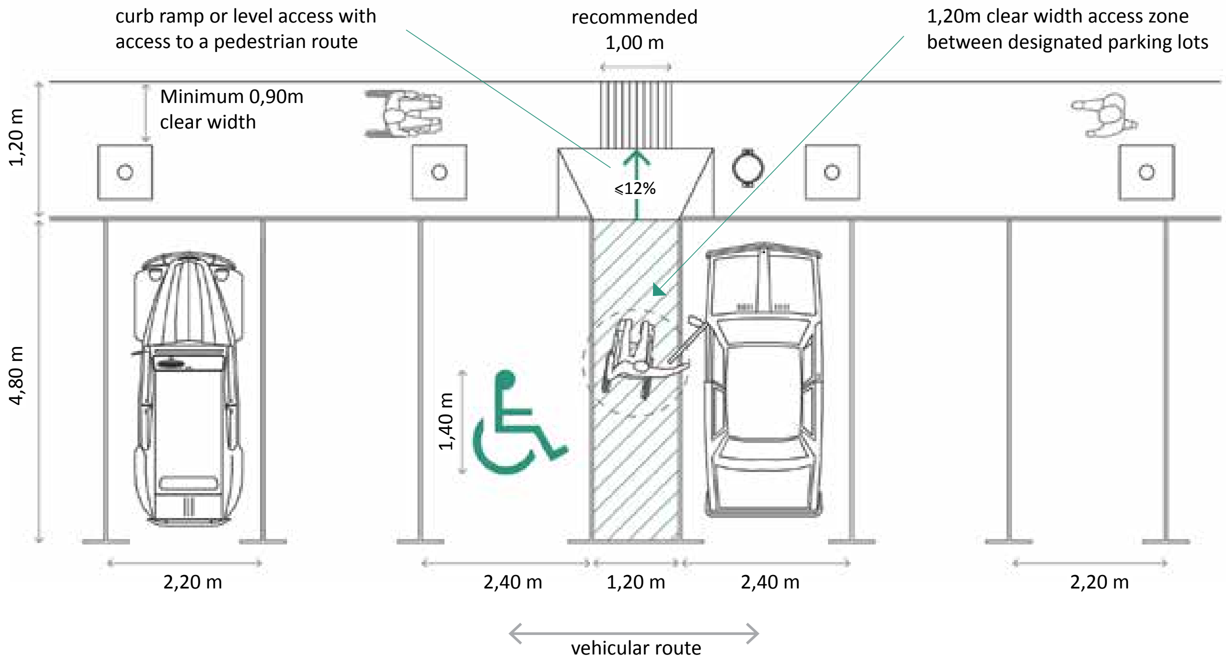


Figure 3.2: key dimensions for parking lots and drop-off zones for disabled people

Figure 3.3: pathway dimensions

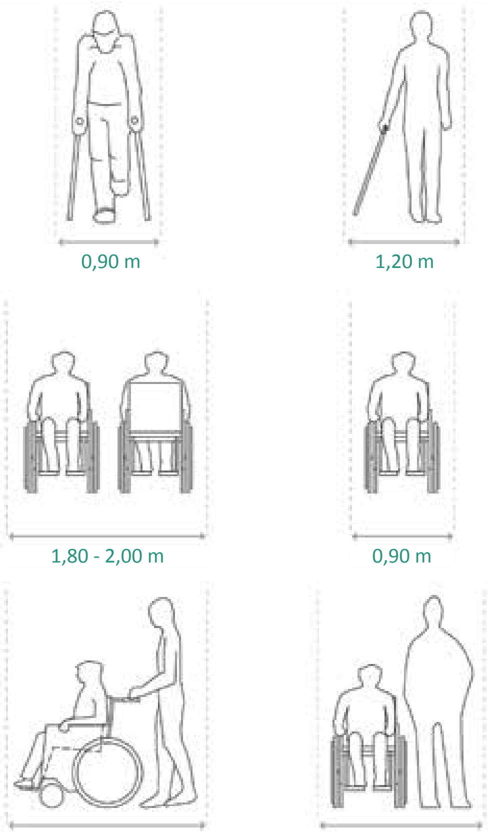
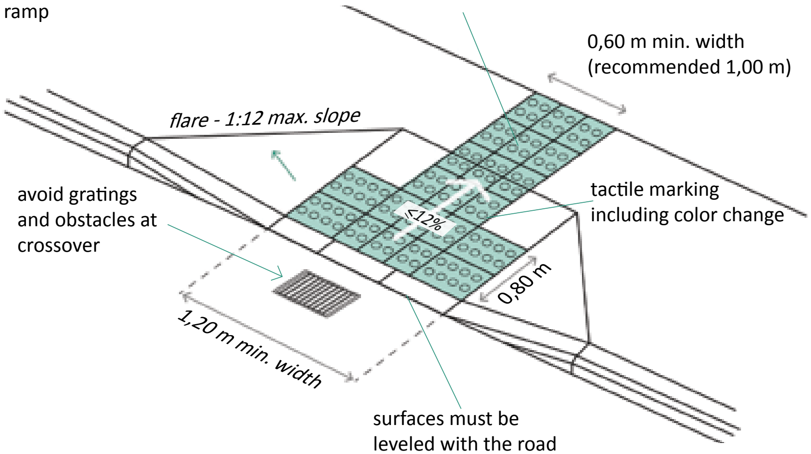


Figure 3.4: key dimensions and features of a curb ramp



3.1.3 Pedestrian routes

The exterior routes should have a minimum clear width of 1,50m (Figure 3.3). This width can be reduced to 1,20m where the path connects with a curb ramp (Figure 3.4).

As mentioned in the introduction, South Sudan is has a sub-humid climate and the average yearly rainfall is about 1000 mm (between the months of April and October).[1] Therefore, subject to the school's particular location, the design of the routes require a close attention to provide sheltered path, slip-resistant and well-drained surfaces along the route.

The routes should be easily accessible, level or ramped. Special attention should be given to people with visual impairments in a way that routes contain:

- proper external lighting;
- legible signage (see subsection 6.4.1 for *signage*);
- sufficient head clearance of objects that are mounted or protrude into a route (see Figure 4.5 in subsection 4.2.1 for *corridors*);
- recognizable payment area by contrasting colors, texture or guide strips to assist independence navigation. (See subsection 6.4.3 for *tactile marking*)

In addition, The pedestrian routes should be clearly defined and safe for people who have less awareness of their surroundings and the risks of traffic (e.g. people with visual, hearing and cognitive impairments). To do this the footpath edges must be defined with either curbs, low rail or a surface change (Figure 3.5). (See also Figure

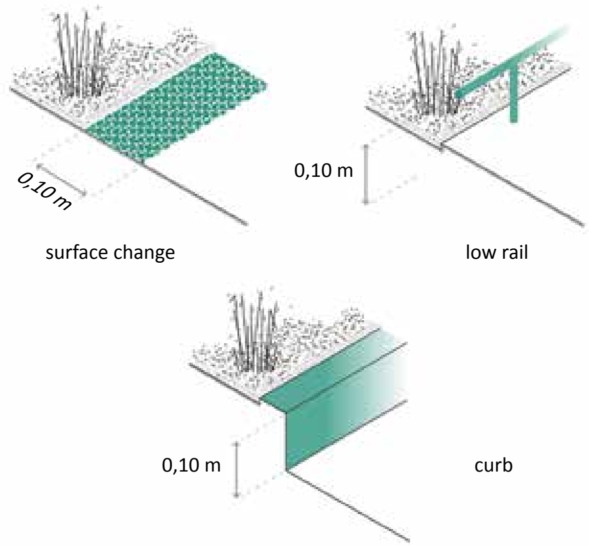


Figure 3.5: Define path edges to provide tactile and visual warnings for people with sensory impairments.

4.23 in § 4.5 for doors and windows opening towards the outside).

The gratings and covers should be leveled with the pavement. The stripped opening in gratings should not be more than 13mm wide and the circular openings not more than 18mm. Figure 3.6 shows a dangerous gratings with large openings.

Figure 3.6: gratings with stripped openings of more than 13mm wide are dangrous for people who use mobility aids.

1 From *Geography of South Sudan*, by Amanda Briney, 2014, retrieved from: http://geography.about.com/od/sudanmaps/a/south-sudan-geography.htm

3.2 EXTERNAL LEVEL CHANGE

In a sub-humid climate such as South Sudan, in order to decrease the absorption of humidity and increase the natural ventilation in the building, it is necessary to design a building that is raised above the ground.[2] Therefore, to level the differences between indoor and outdoor area, ramps and stairs must be used. The use of exterior ramps and stairs should meet the following requirements:

3.2.1 Exterior ramps

Ramps can be used both outside and inside the building. However, an exterior ramp is recommended as indoor ramps occupy a large amount of space. In order to use the space efficient, ramps can have different configurations that match the best with the form and availability of space. Figure 3.7 illustrates different possible configuration forms of ramps.

The minimum clear width of the ramp must be 0.90 m. However, depending on the purpose of the ramp, this width can vary. (See Figure 3.3 in § 3.1, subsection 3.1.3)

The ramp must not have a maximum running slope of more than 1:20. Depending on the length that the ramp cover, steeper slopes may be allowed (Figure 3.8). Table 3.1 indicates the relation between the slope, length and the rise of the ramp.

All ramps should be provided with level platforms (landings) for maneuvering , resting and avoiding excessive speed. Landings must be provided, at top and bottom, every 10m long for every ramp. In addition, landings must be provided where there is a change in direction of the ramp (Figure 3.7).

Landings must have a minimum length of 1,20m and a minimum width equal to the same width of the ramp for a straight run ramp.

For other configurations forms of ramps where there is a change in direction of the ramp, different dimension may apply to provide enough space for full maneuvering of wheelchairs. Figure 3.9 illustrates the different recommended dimensions based on the required turn in various ramp configuration forms.

2 See *Shaping Buildings for the Humid Tropics,* by Patti Stouter, ASLA, 2008, retrieved from: http://www.greenhomebuilding.com/pdf/shapingbuildings1.pdf for more information regarding sustainable design guidelines for low-cost buildings in a tropical climate

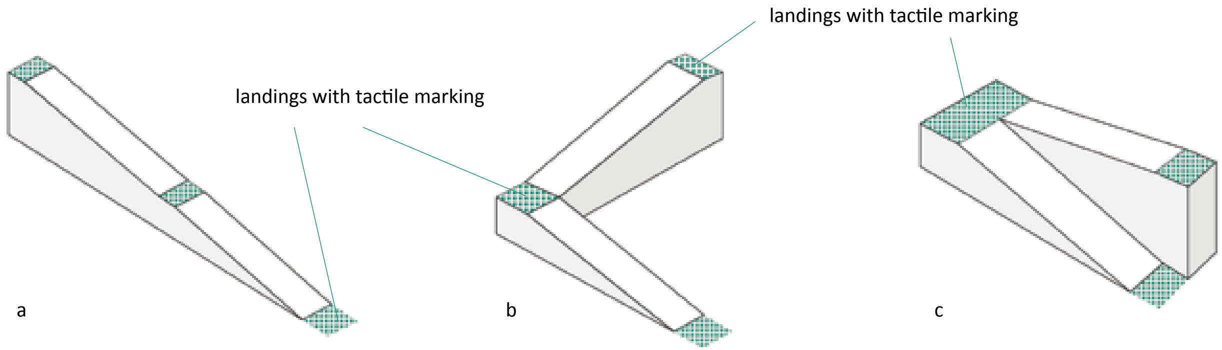


Figure 3.7: various ramp configuration forms; Straight run (a); 90 turn (b); Switch back or 180 turn (c). (source: PHOS, 2005)

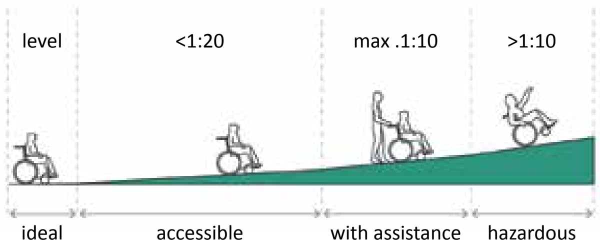


Figure 3.8: ramp's running slope (source: PHOS, 2005)

Table 3.1: relation between the slope, length and the rise of the ramp (source: PHOS, 2005; LABC, 2010)

MAXIMUM SLOPE	MAXIMUM LENGTH	MAXIMUM RISE
1:20	10 m	0,60 m
1:16	8 m	0,50 m
1:14	5 m	0,35 m
1:12	2 m	0,15 m
1:10	1,25 m	0,12 m
1:08	0,50 m	0,06 m

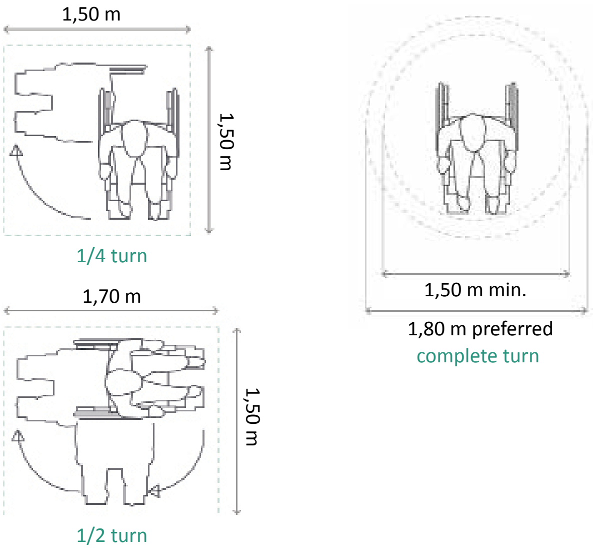
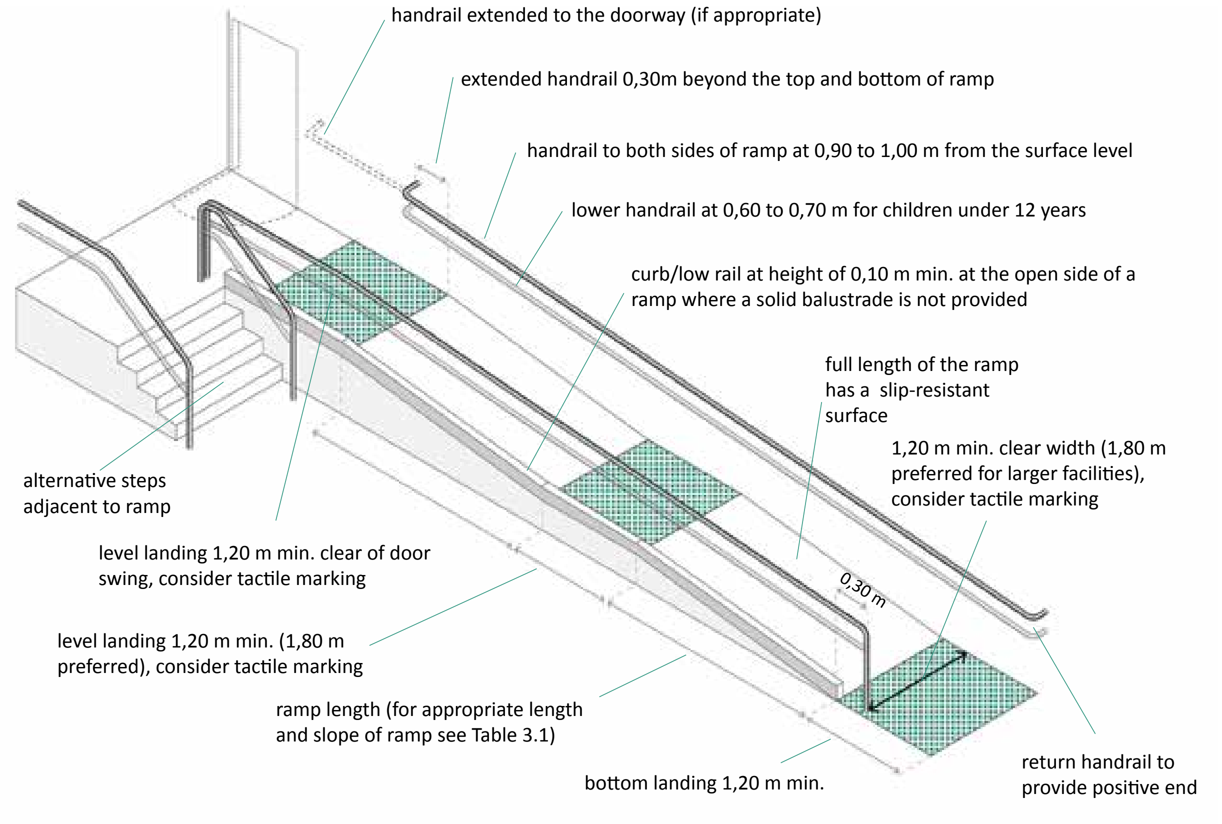


Figure 3.9: key dimensions for having enough room to turn depending on the ramp configuration.

Figure 3.10: key dimensions and features of designing a ramp



(Source: Simplified Building Concepts, 2010)

Figure 3.11: use of handrails for ramps.

Figure 3.10 shows the key features and required dimensions for designing a ramp.

A ramp must be equipped with handrails on both sides of the ramp which continue along its entire length (including the landings).

A protective handrail extends horizontally at least 0,30m beyond the top and bottom of the ramp, and ends in a way that will not create a hazard or disturb pedestrian travel.

Handrails should be installed between 0,90m and 1,00m high, measured vertically from the surface of the ramp for **adult students**. A second low handrails must be installed with its top surface 0,60m from the ramp surface for **younger students** (aged under 12).

Sufficient vertical clearance between upper and lower handrails of a minimum of 0,25m should be provided to prevent entrapment (Figure 3.11).

For ramps more than 3,00m in width, an intermediate handrail should be installed and located in a way that when both sides are used for gripping, the distance between handrails does not exceed more than 1,40m. The detailed design of handrails must meet the requirements set out in subsection 3.2.3.

The ramp must have edge protection to guide visually impaired students that use a long cane. This can be provided with a wall, curb, railings or other barriers which extend to at least 0,05m of the finished ramp surface.

Where the difference in height between the ground level and the top of the ramps exceed more than 0,60m, guards or walls are required on the both sides of ramps. The hight of the guard must be 1,10 m above the ramp surface. The guard should be carefully designed in a way that does not facilitate climbing for children (Figure 3.12).

The surface of the ramps should be firm and slip resistant and be equipped with tactile marking (See § 6.4, subsection 6.4.3 for *tactile marking*)

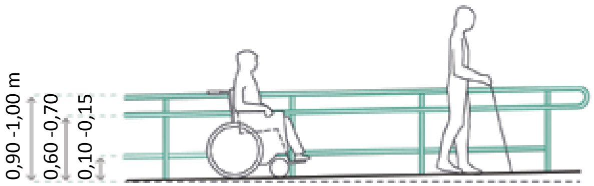
In the **existing buildings** where the permanent ramp cannot be implemented, a temporary/ movable ramp should be provided as an alternative.

3.2.2 Exterior stepped routes
For external level changes, stairs should be provided as an alternative to ramps.

Circular forms for stairs and landings must be avoided.

Figure 3.13 illustrates the key requirements and design features of exterior stairs.

The stairs should have a consistent rise and going throughout the flight. For school buildings,



Railing is used at a height between 0,10 m and 0,15 m

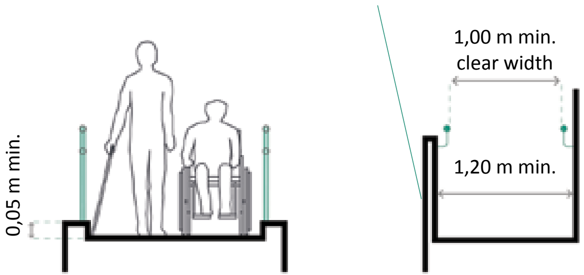


Figure 3.12: when a ramp is at a exposed location, a solid guard, wall or combination of handrails with curbs is required.

the preferred dimensions of stairs is a 0,15 m maximum rise and a 0,28 m minimum going.

Stairs must have closed risers.

The minimum clear width of the stairs must be 0.90 m. However, depending on the designed traffic of the stairs (one-way or two-way traffic), this width can vary. (See Figure 3.3 in § 3.1)

A textural hazard warning surface should be placed at the top, intermediate and bottom landings of a series of flights to warn people with visual impairment for a change in level. (See Figure 3.13)

Where the stairs covers a level change of more than 2,50m, an intermediate landing must be provided. The landing should have a minimum of 1,20m in length and the equal width for the stairs.

Stairs should have contrasting nosings. The nosings should not be sharp and not be projected more than 0,02m.

Handrails should be installed on both sides of the stairs and around the landings. The handrails must satisfy the requirements set out in subsection 3.2.1 for *exterior ramps.* Subsection 3.2.3 for *handrails* provide the set up requirements for the detailed design of handrails.

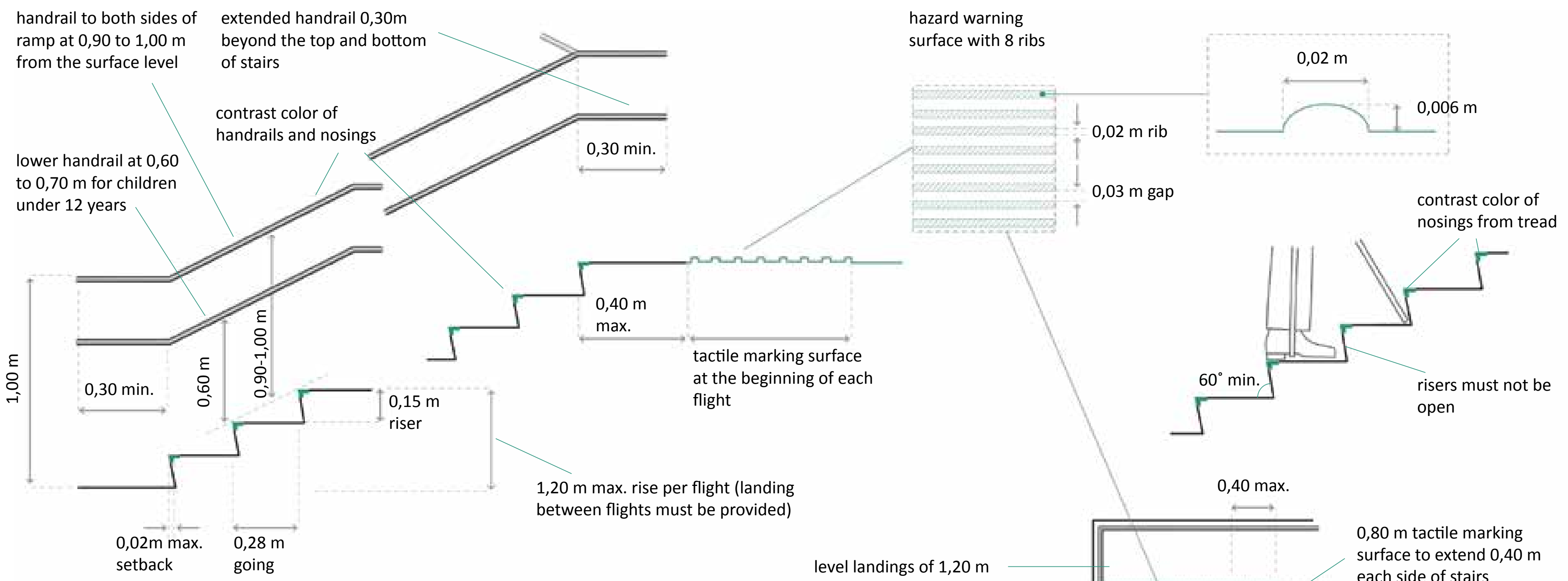
For stairs that are wider than 3,00m, an intermediate handrail should be installed and located in a such a way that the distance is between 0,90m to 1,40m (Figure 3.14).

Where the difference in level change between the ground level and the top of the stairs exceeds more than 0,60m and there is no wall in the outside edge of the stairs, a guard is required on the sides of the stairs. This guard must not be less than 0,92m above the nosing edge and 1,10m around the landings. The guard should be carefully designed in a way that does not facilitate climbing for children.

The surface of the stairs in landings, treads and nosing must avoid any projections and be slip-resistant.

In the **existing buildings** when the form of the nosing cannot be modified, applying a slip-resistant strip to the existing nosing with a color contrast is a solution. These additional strips should be 0,04m wide and do not extent more than 1 mm above the going surface to avoid tripping hazards. (Figure 3.15)

Figure 3.13: key requirements and design features of exterior stairs.



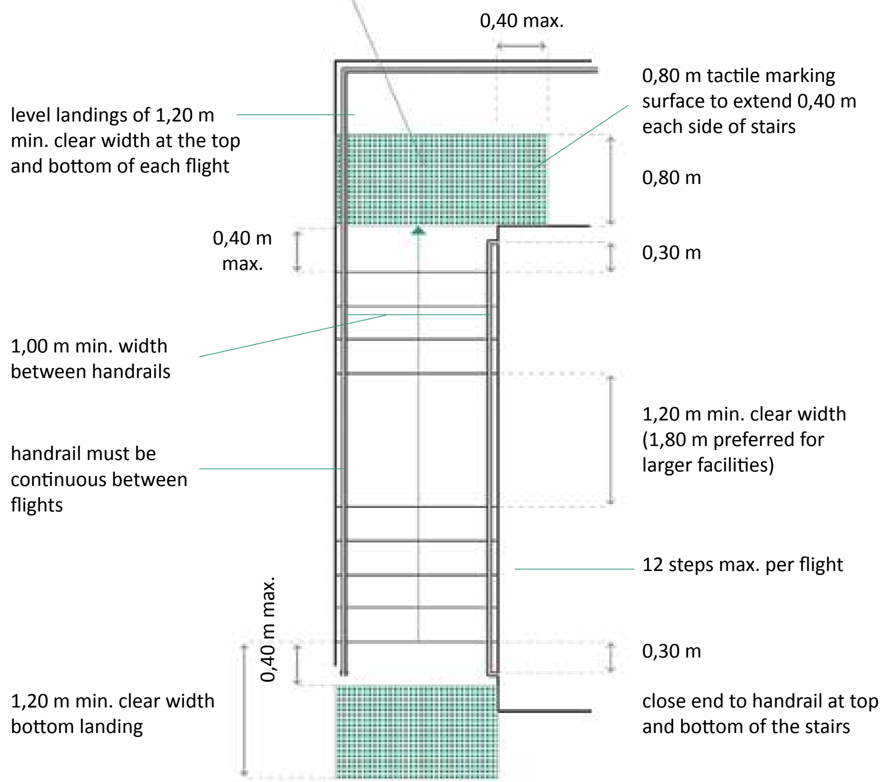
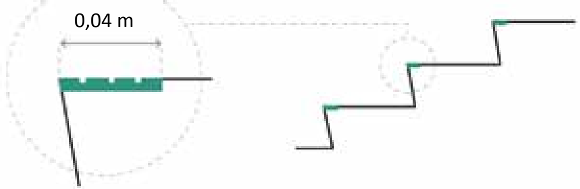


Figure 3.14 : an intermediate handrail is required when the sitars are wider than 3,00 m

Figure 3.15: applying a slip-resistant strip to the existing nosing with a color contrast which is 0,04 m wide and dooes not extent more than 1 mm above the going surface



3.2.3 Handrails

The use of handrails and railings are important, in order to assist disabled persons to increase comfort and to provide safety.

Handrails must be used in any level changes (even small ones), and provide adequate grip and support (Figure 3.16).

Handrails should not project into the minimum clear width of the ramp, stair or corridor (Figure 3.17).

When handrails are attached to a wall, a clearance of not less than 0,05m between the handrail and any wall should be provided

Handrails must have a circular cross-section of between 0,045m and 0,05m for the outside diameter for **adult students** and 0,04m to 0,045m for the diameter for **younger students** (aged under 12).

Handrails should be installed between 0,90m and 1,00m high, measured vertically from the top of the gripping surface from the ramp surface or stair nosing for **adult students**. A second low handrails for stairs and ramps must be installed when students under 12 years are the principle users in the educational building/facility. An appropriate height of between 0,60m to 0,70m maximum from the ramp surface or stair nosing should be provided to assist younger students (Figure 3.18).

Sufficient vertical clearance between upper and lower handrails of a minimum of 0,25m should be provided to prevent entrapment.

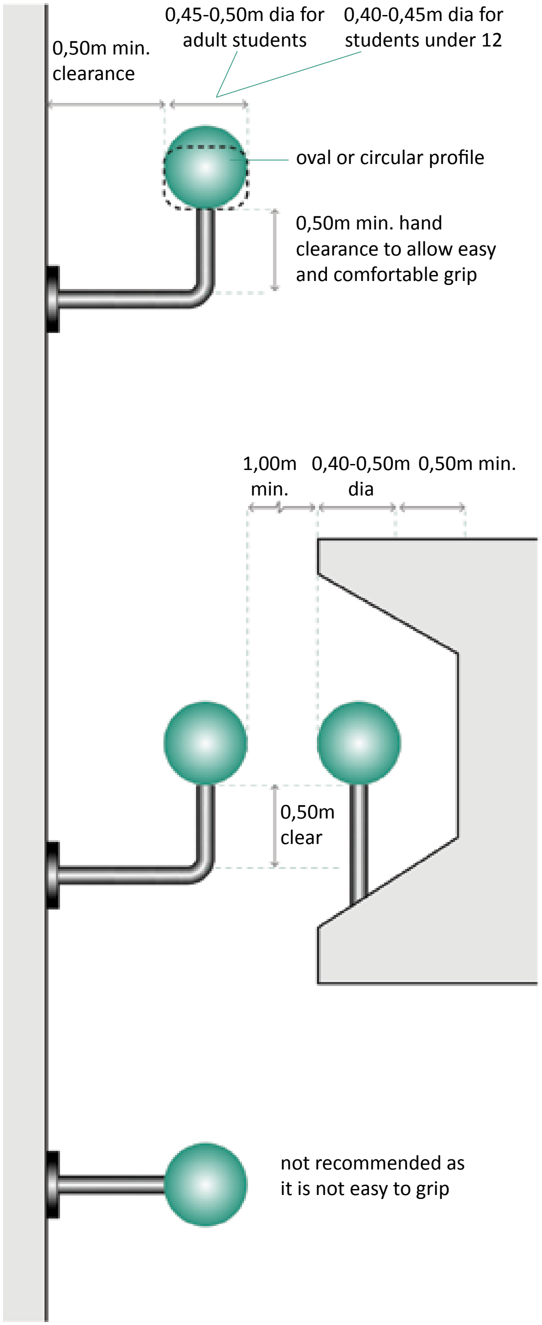


Figure 3.16: key dimensions and design features of handrails

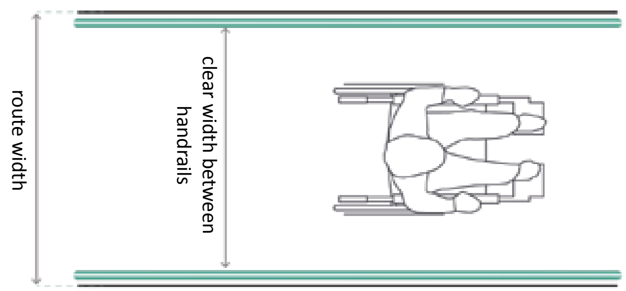


Figure 3.17: the minimum clear width of ramp, stair or corridor should be considered the in-between distance of handrails on both sides.

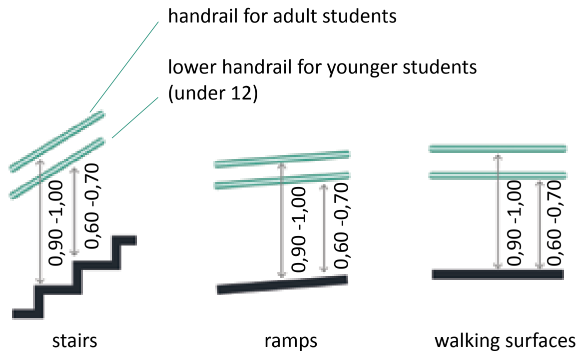


Figure 3.18: appropriate handrails height for stairs, ramps and walking surfaces

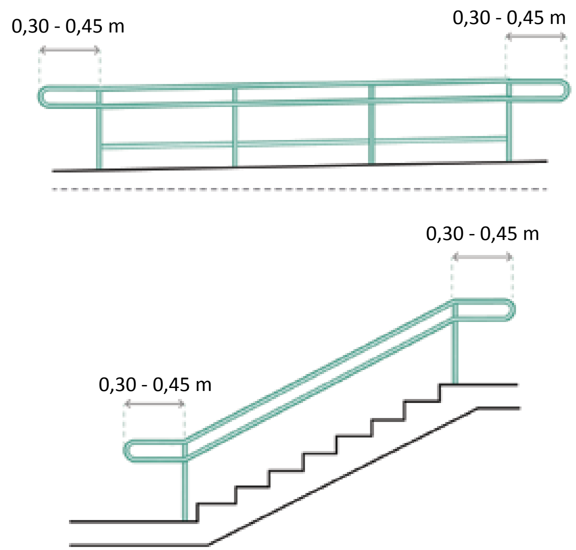


Figure 3.19: required termination of handrails on stairs and ramps

Figure 3.20: handrails must contrast visually from the background and should not be reflective

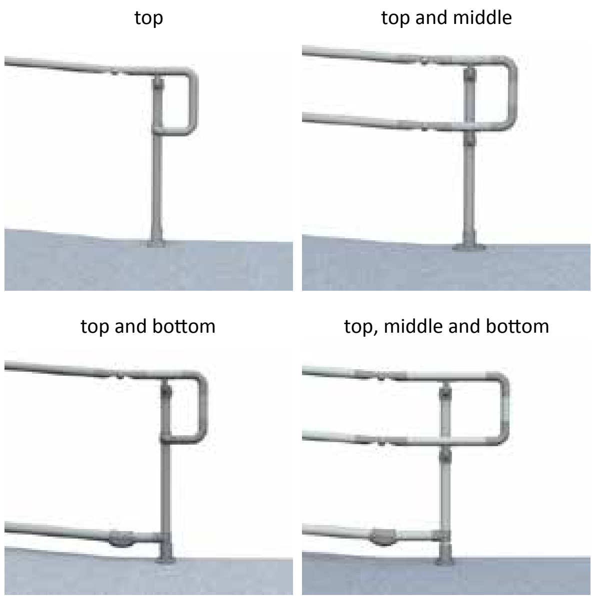


Figure 3.21: different railing configurations for students with disabilities (Source: Simplified Building Concepts, 2010)

Handrails must be continuous along their entire length of stairs and ramps. They should terminate with a minimum of 0,30m of 'returned ends' which pass the first/last risers of a staircase and the top/bottom of ramps (Figure 3.19). However Handrails should terminate in a way that does not obstruct student movement or creates a hazard.

Handrails color and brightness must contrast visually against their background to be easily distinguishable (Figure 3.20).

Balustrades/guards must be combined with the handrails (when needed) to provide physical and visual security along the ramps and stairs.

Figure 3.21 shows different railing configurations that can be used when designing handrails that are appropriate for students with disabilities.

3.3 BUILDING ENTRANCE

The main entrance to the building should be accessible and clearly visible to the people approaching the building. It should also be very close to the drop-off area and disabled parking.

The accessible entrance must be well lit, contrast visually and be clearly signposted using the international symbol of access including the principal entrance when this is not the accessible entrance (Figure 3.22).

The entrance should be easily distinguishable from the facade and be clear of any structural supports which can be a hazard for people with visual impairment (Figure 3.23).

It must have a level landing of minimum 1,50 m by 1,50 m clear of any door swings in front of the entrance. The surface material and matting should be leveled with the floor to avoid potential tripping hazards. (See also § 4.2, subsection 4.2.2 for *doorways and vestibules*)

Figure 3.22: a clear signpost indicating the alternative entrance for disabled access to the building

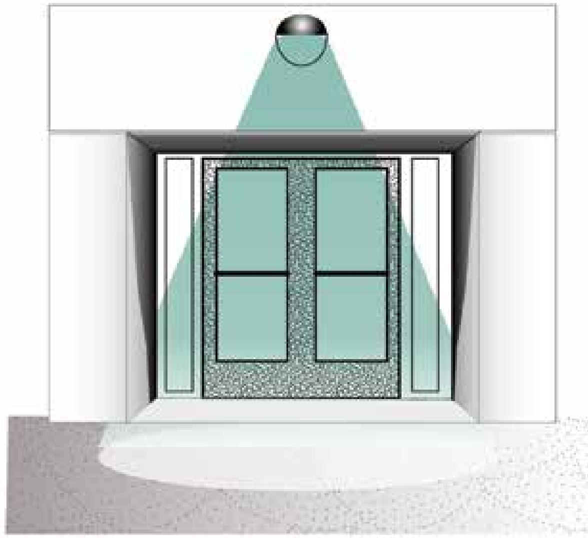


Figure 3.23: use of color contrast, good lighting and different texture is recommended in designing entrances so they can be easily distinguishable form the facade and from a distance, (source: building bulletin 91)

Entrance doors and glazed entrances must be marked at both standing and seated eye levels (See § 4.5, subsection 4.5.1 for *doors*).

The use of full glazed door is not recommended, as it creates confusing environment for visual impaired people and decreases safety and visibility.

When a glass entrance and glazed screens are used, they should be clearly defined with manifestation on the glass (Figure 3.24). (See § 4.5, subsection 4.5.1 for *doors*).

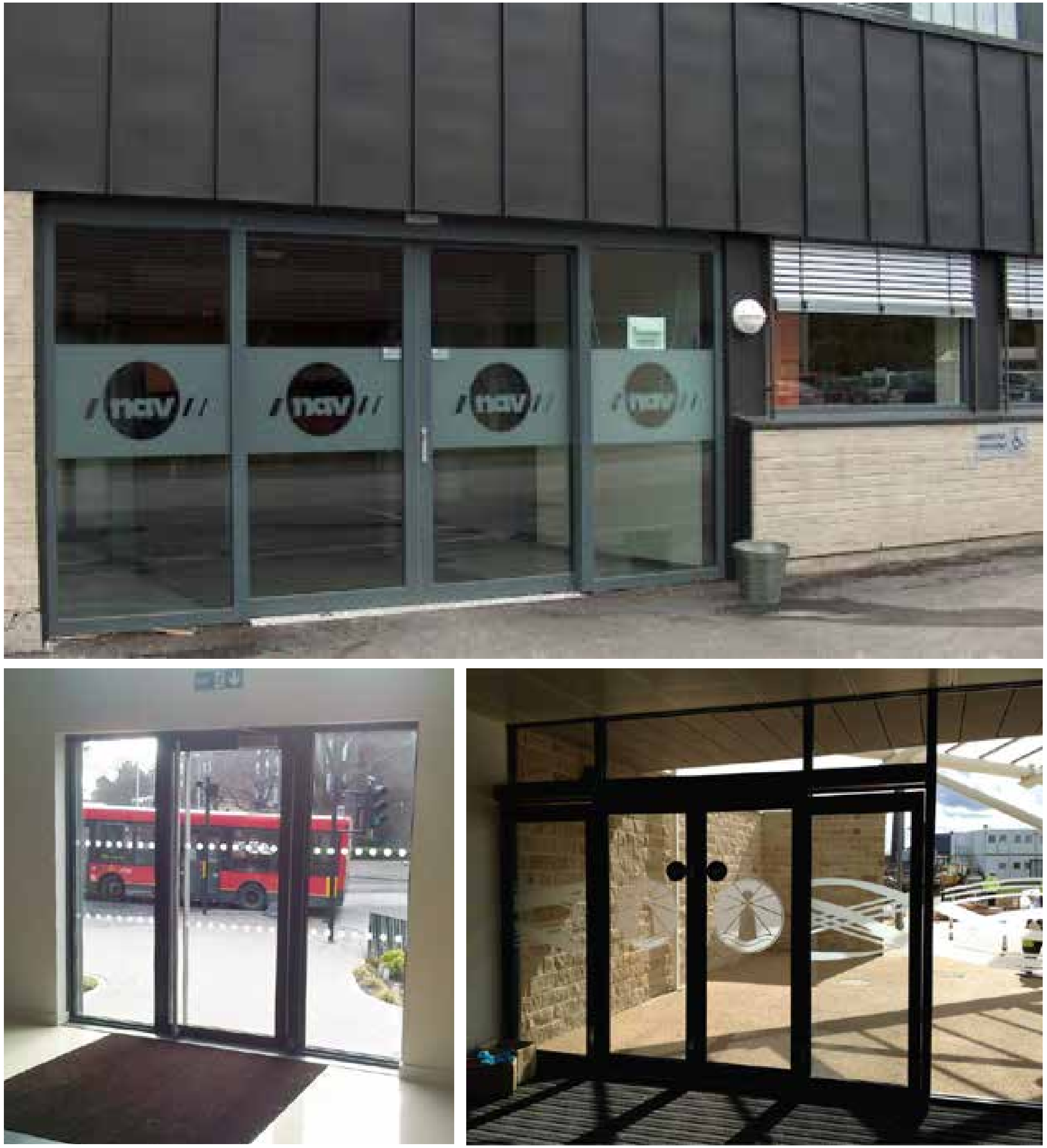


Figure 3.24: glass entrances are clearly defined with manifestation on the glass

DESIGN GUIDANCE WITHIN EDUCATIONAL BUILDINGS 4

RECEPTION AND ENTRANCE HALL

HORIZONTAL CIRCULATION

CORRIDORS

DOORWAYS AND VESTIBULES

INTERNAL LEVEL CHANGE

RAMPS

STAIRS

ELEVATORS AND PLATFORM LIFTS

SANITARY FACILITIES

BUILDING ELEMENTS

DOORS

WINDOWS AND SCREENS

CHAPTER 4: DESIGN GUIDANCE WITHIN EDUCATIONAL BUILDINGS

This chapter gives a fully detailed and inclusive guideline for accommodation within the buildings. It outlines the key design guidelines for the ensuring of an inclusive learning environment for student with disabilities.

4.1 RECEPTION AND ENTRANCE HALL

The reception and entrance hall should be welcoming, attractive and student-friendly.

Lobbies and entrance halls must be designed in a way that a transition lighting zone is offered to reduce the contrast between the exterior and interior of the building for people with visual impairments.

The dimension of the Lobbies should allow wheelchair users to maneuver fully and freely. (See subsection 4.2.2 for guidance for *doorways and vestibules*)

Any reception/information desk and counter should be easily identified. The counter should also have a lower section and knee recess of at least 0,50 m deep, usable for wheelchair users and should be well lit (Figure 4.1 and 4.2).

Whether a building has a reception/information desk or not, the entrance hall should be provided with visual and tactile signposts where students and visitors can stay and read them without making any conflict for circulation of others.

The entrance hall is recommended to have (See Figure 2.1 in § 2.2):

- a storage place for the personal belongings and mobility equipment;
- accessible toilet(s)/changing room which are clearly signposted;
- a parents' meeting room located nearby;
- a waiting area close to the reception providing seating and space (this includes wheelchair users);
- displays of students' work to enhance the sense of belonging, well organized and designed in a way that does not impede the circulation and causes any hazards.

4.2 HORIZONTAL CIRCULATION

As mentioned previously in Chapter 3, navigation and movement are part of the learning process that many children with disabilities encounter. An inclusive environment should enable the disabled students to move around alongside their classmates.

The students with impairments may require different types of supervision and support. They might use wheelchairs, frames and other mobility aids. They may require handrails along corridors or need support and assistance of staffs to walk beside them. Therefore, some children may require a considerable clearance space in order to be able to get the aforementioned support. For example, students with hearing impairments require space to gesticulate while walking and a staff walking together with an visual impaired student will take up more space than usual.

The internal circulation space should get special attention in designing an educational building. A well lit, airy and pleasant ambiance to enhance positive behavior of students is

Figure 4.1: an accessible counter with knee recess appropriate for wheelchair users

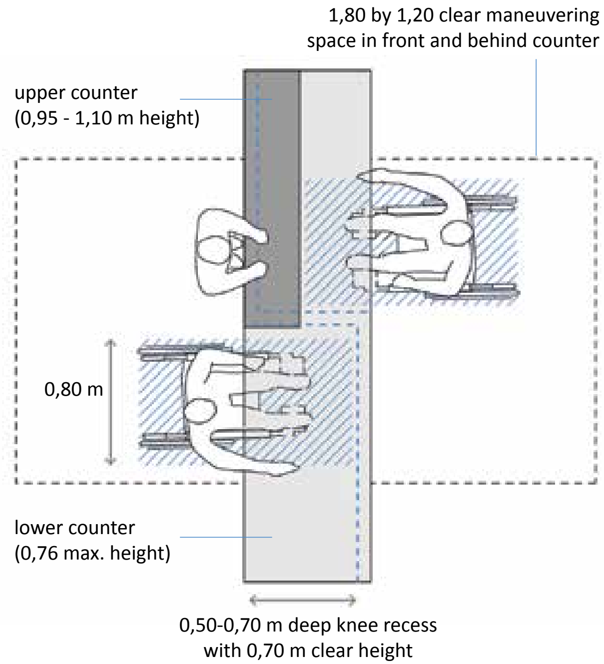


Figure 4.2: key dimensions of reception/ information desk

strongly recommended. This can be achieved by, for example, displays of student's works that are hanged on the walls (without any projection point to create any hazards), or using bays off circulation routes to allow students to sit and interact with their peers, rest and calm down while others are passing. However, the latter requires to let passive supervision by principle staff and provide a clear sight lines as hidden spaces may encourage inappropriate behavior.

For fire safety, there should be clearly visible outdoor accesses and emergency escapes planned carefully in the internal circulation (in accordance with the fire safety regulations of the country). Fire extinguishers and fire hoses should be positioned in a way that they are easily accessible while not obstructing the circulation or creating hazards for students (Figure 4.3).

Substantially, in order to assist students to orientate themselves in the school, the internal circulation space should be clearly signposted and have a variety of sensory wayfinding techniques (e.g. signs, color, symbols, sound, texture, etc.) (See § 6.4).

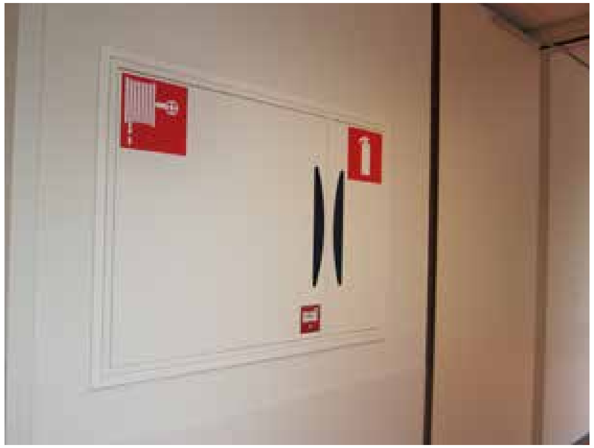


Figure 4.3: a well organized fire extinguisher and hose in the corridor which is leveled with the wall surface and positioned in a way that does not impede the circulation or create any hazards (Bartimeus facility in the Netherlands)

4.2.1 Corridors

Corridors must be wide enough to allow independent wheelchair maneuver and movement of visual impaired students. Narrow and long corridors should be strongly avoided.

Corridors must have a minimum clear width of 1,80m for at least two wheelchair users to pass easily in different directions. However, for corridors leading to more than two classrooms, a clear width of 2,00m, with a minimum of 2,70m to 3,00m clear width in the main circulation area is recommended.

When there are doors located along major access routes, no opening should project into the corridor.

In cases that handrails, lockers or movable furnitures are used in corridors, the previously mentioned dimensions are valid only when the clear width in between these elements are measured.

Protruding objects in the corridors (e.g. drinking fountains, fire hoses, columns) should be placed outside the circulation path and must not reduce the clear width required for accessible routes (Figure 4.4).

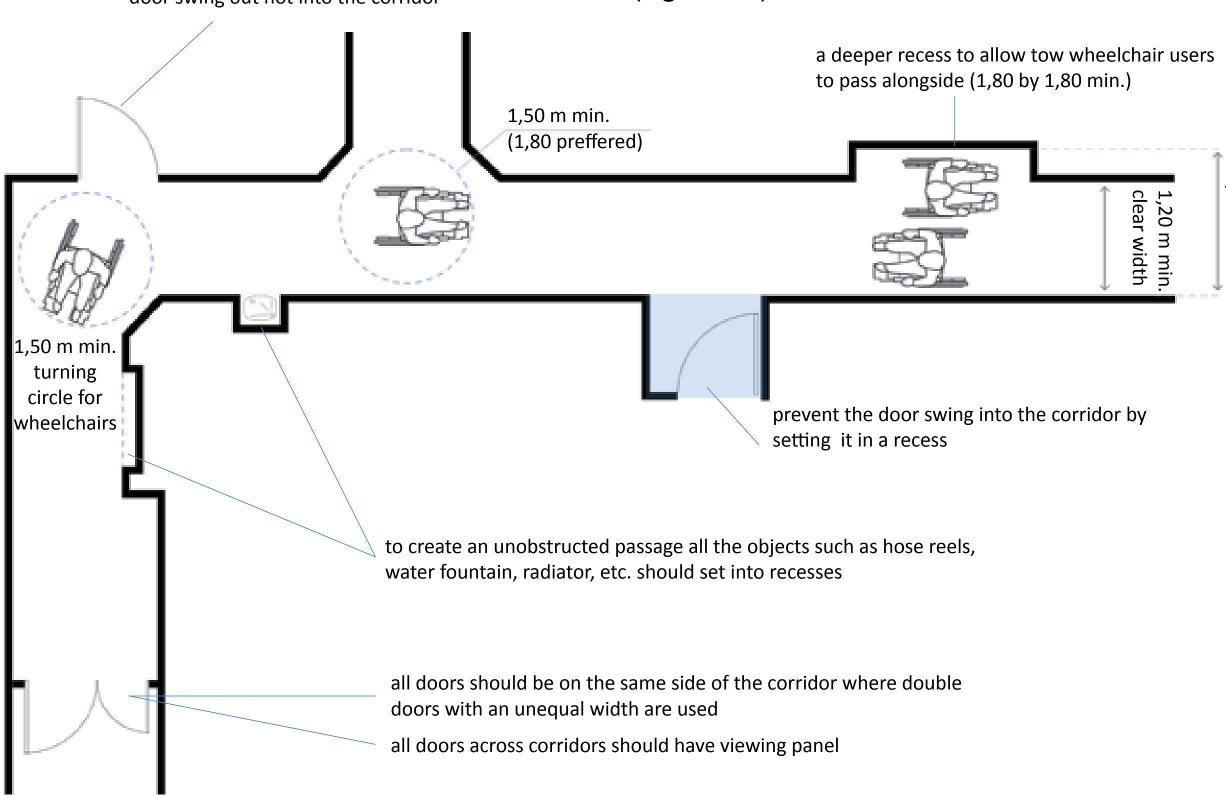


Figure 4.4: key dimensions of internal circulation

In the **existing buildings**, when this is not possible, clear means of directing should be provided around these obstacles (e.g. a visually contrasting guardrail).

The vertical clearance in corridors should be at least 2,00 m high. Any overhanging signs should be mounted above this level.

When there are obstacles mounted between 0,70 m to 2,00 m above the ground and they are protruded more than 0,10 m to the corridor, guardrails or other detectable barriers must be provided. Guardrails or any detectable barriers should be located in maximum 0,70 m above the ground surface to warn visual impaired students for hazards (Figure 4.5).

4.2.2 Doorways and vestibules

Doorways and vestibules should be designed in a way that enables a wheelchair user to maneuver between two sets of doors. It should allow a disabled person to move/turn clear of the first door, before dealing with the second door (Figure 4.6).

For narrow vestibules in the **existing buildings** either of the following solutions (if possible) can be applied to make them accessible:

- the swinging doors should be replaced with sliding doors;
- modify the opening direction of doors to swing outwards;
- remove one of the doors;
- extend the existing vestibule and move one of the doors further (Figure 4.7).

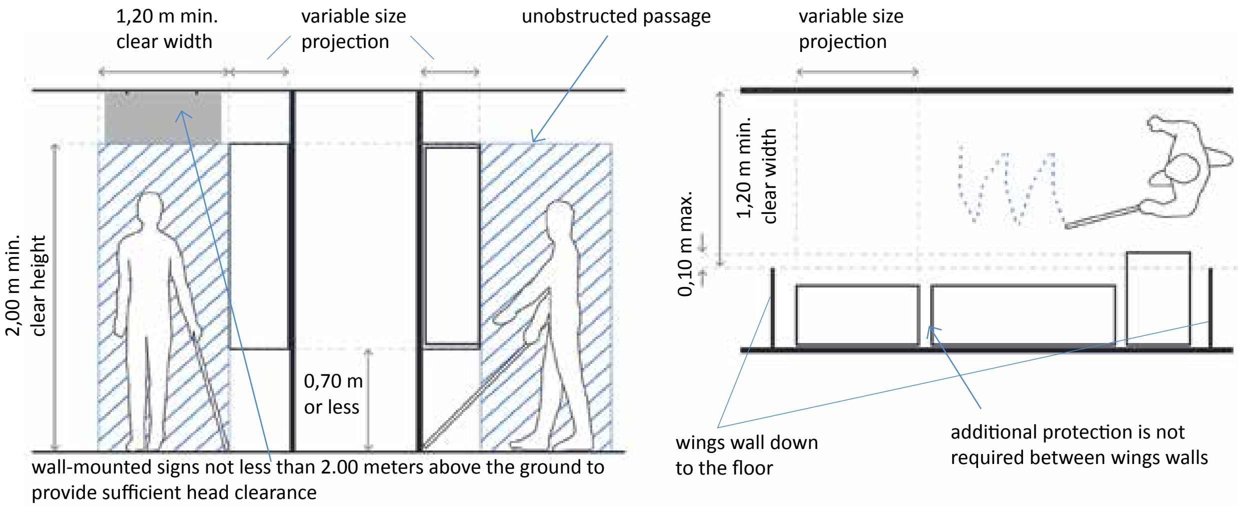


Figure 4.5: key dimensions and design features for clear width and height clearance in the corridors

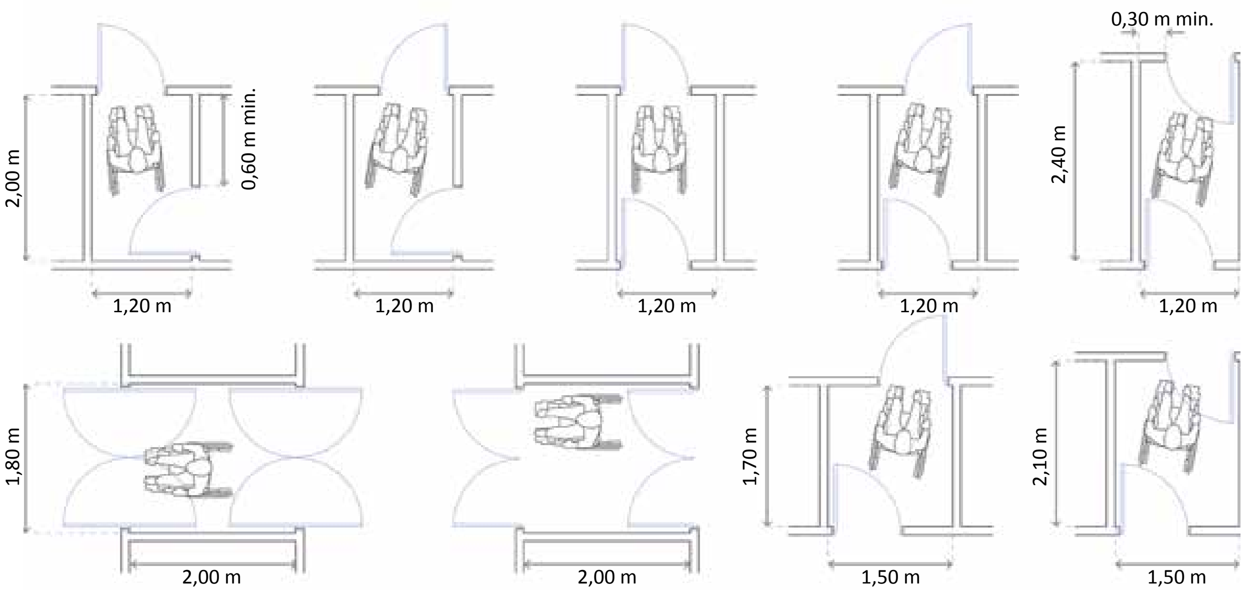


Figure 4.6: key dimensions and variations of doorways and vestibules

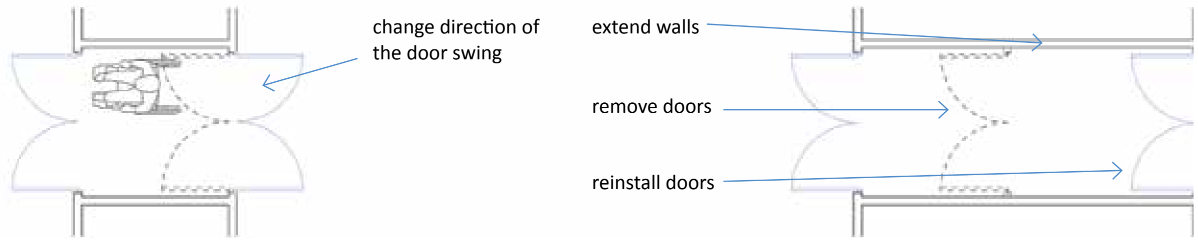


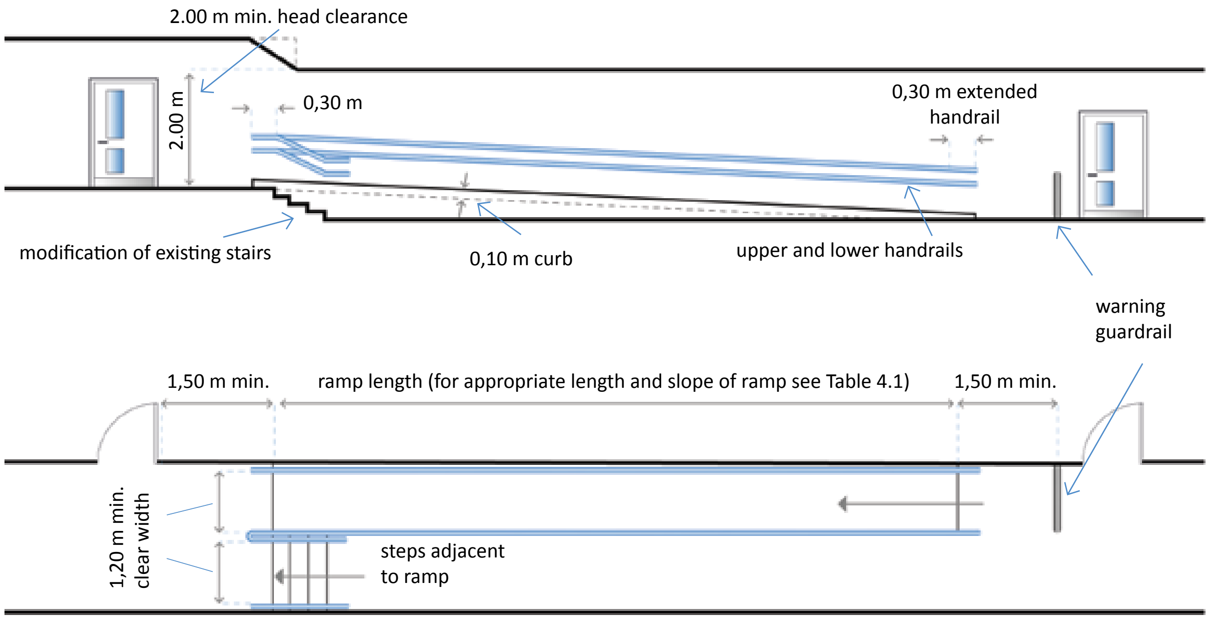
Figure 4.7: various solutions to make narrow vestibules accessible in the existing buildings

Table 4.1: key dimensions for ramps

CLEAR WIDTH		
1,20m minimum - 1,80m preferred		
RAMP SLOPE		
Slope	Length	Rise
1:20	10 m	0,60 m
1:16	8 m	0,50 m
1:14	5 m	0,35 m
1:12	2 m	0,15 m
1:10	1,25 m	0,12 m
1:08	0,50 m	0,06 m
LANDINGS		
1,2m minimum length width (minimum)= same width of the ramp		

Figure 4.8: an alternative short flight stepped route next to the ramp inside the building

Figure 4.9: key design features and dimensions of ramped adaptations into an existing corridor, (source: building bulletin 91)



4.3 INTERNAL LEVEL CHANGE

The most common ways of achieving change of level within a building are the use of stairs and ramps. Elevators and platform lifts may also be used in a multi-story building. However, this depends on the financial resources of organizations, size and number of students in need of lifts and also technical conditions of the building (particularly in the existing buildings).

Within a building, a choice of routes should be provided. This is because of the fact that some students who can walk but have restricted mobility, may find it easier to use a short stair rather than a ramp.

4.3.1 Ramps

As mentioned in § 3.2, subsection 3.2.1 *for exterior ramps*, indoor ramps occupy a large amount of space. Therefore, small level changes in corridors are not recommended.

The design guidelines regarding the width, slope, handrails and material for ramps are the same as provided in § 3.2, subsection 3.2.1 *for exterior ramps.* Table 4.1 summarizes the key dimensions for designing ramps.

It is crucial to provide a short stair next to a ramp , specially when a steeper and complicated configuration of ramp is used for change in level. As mentioned earlier, a short flight of steps is sometimes more suitable to use rather than a ramp for ambulant disabled students (Figure 4.8).

Figure 4.9 illustrates the key design features and dimensions of ramped adaptation inside a building.

4.3.2 Stairs

The design guidelines regarding the width, the rise, the going, the provision of handrails and the landings for stairs comply with § 3.2*,* subsection 3.2.2 for *exterior stepped routes.* However, the following considerations are necessary for indoor stairs.

In an educational building where stairs are not often used, a minimum width of 1,20 m is permitted. However, a clear width of 1,60m is recommended inside the building. This allows two adults to pass each other with ease (even with a wheelchair). (See also Figure 3.3 in § 3.1, subsection 3.1.3)

It is not necessary to provide a hazard warning surface at the head of the internal stairs. However, the nosings of the stairs should be clearly visible at the first and last risers of the staircase (Figure 4.10).

A flight between landings should not exceed more than 12 risers. However, in an existing buildings where the plan area is restricted, 16 risers may be provided.

The dimensions of internal landings should provide enough room to allow students (when necessary) to rest between flights without causing any obstruction for other students.

The width and length of the landing should be equal to the smallest width of the flight.

Table 4.2 summarizes the key dimensions and Figure 4.11 illustrates the main design features of internal stairs.

CLEAR WIDTH
1,20m minimum - 1,60m preferred
RISE
0,15m - 0,17m (0,15m preferred) not more than 12 risers
GOING
0,25m - 0,28m (0,28m preferred)
LANDINGS
1,2m minimum length width (minimum)= same width of the stairs

Table 4.2: key dimensions for stairs

Figure 4.10: a hazard warning surface only provided on the first step and last step, to warn the starts and ends of internal stairs. However there is a stronger color contrast at the start of the staircase in one floor and the end of it on the other floor with a darker color and different texture.

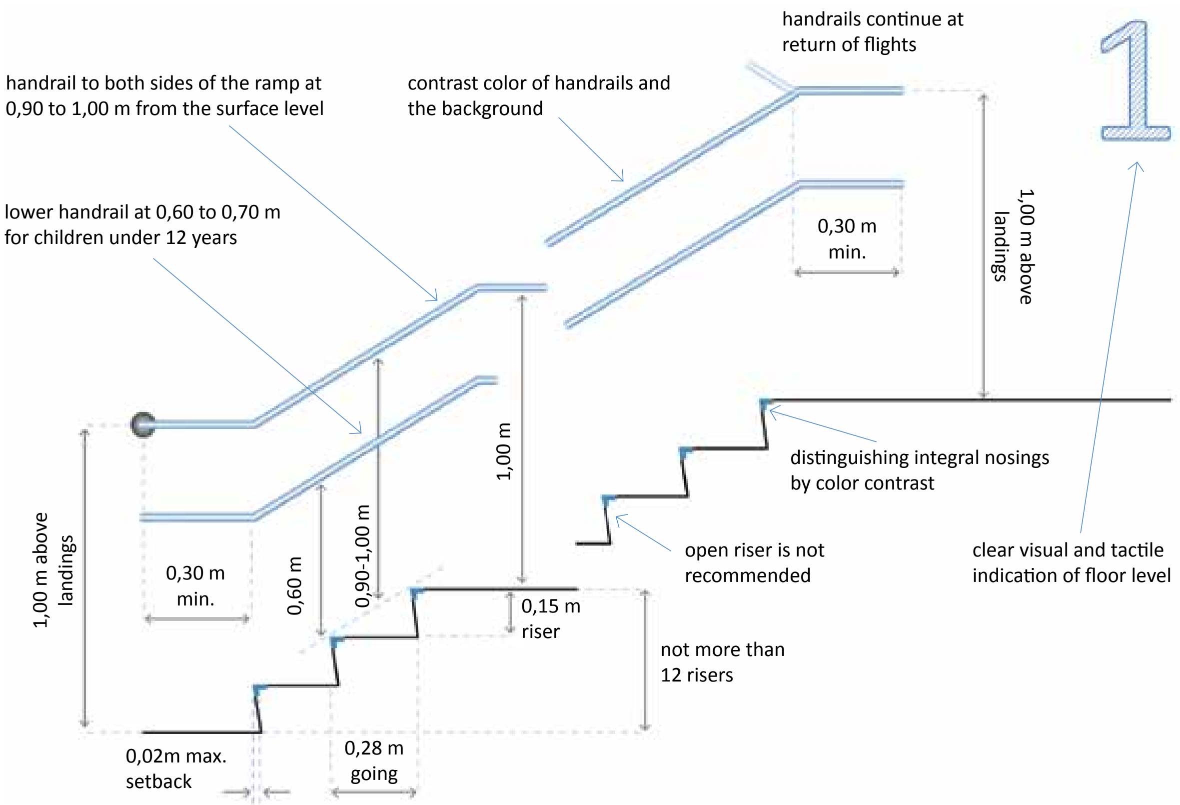


Figure 4.11: key design features and dimensions of internal stairs

4.3.3 Elevators and platform lifts

Elevators or platform lifts can be used for vertical movement of wheelchair users. The necessity, number, size and location of the elevators or platform lifts depends on:

- the available financial resources and organization strategy;
- the number of wheelchair users among students and teachers;
- the use frequency.

<u>*Elevators*</u> should have (Figure 4.12):

- a door opening of at least 0,80m;
- a clear space of 1,50 x 1,50 m minimum of landing in front of the door;
- the internal dimensions of at least 1.00 m by 1.40 m to provide enough room for one wheelchair user;
- a handrail on three sides of the lift car mounted between 0,80m to 0,85m from the floor;
- clearly visible bottom controls within reach of both standing and seated height (not less than 900mm not more than 1200mm above the floor) (Figure 4.13).

<u>*Vertical movement platform lifts*</u> should:

- be installed for level changes of more than 1,20m (less than a full story in height) to maximum level changes of 2,50 m;
- be adjacent to the stairs and be placed in a closed structure with doors at the different accessible levels (Figure 4.14).

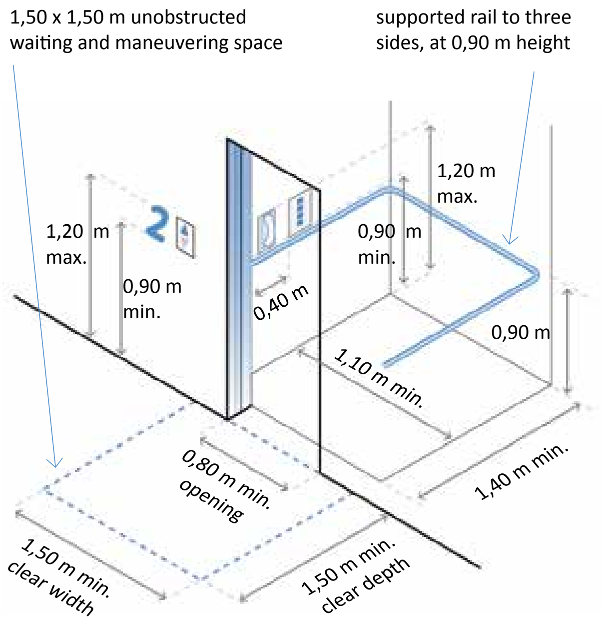


Figure 4.12: key dimensions of elevators

Figure 4.12: raised numbers for control buttons to help people with sight impairments

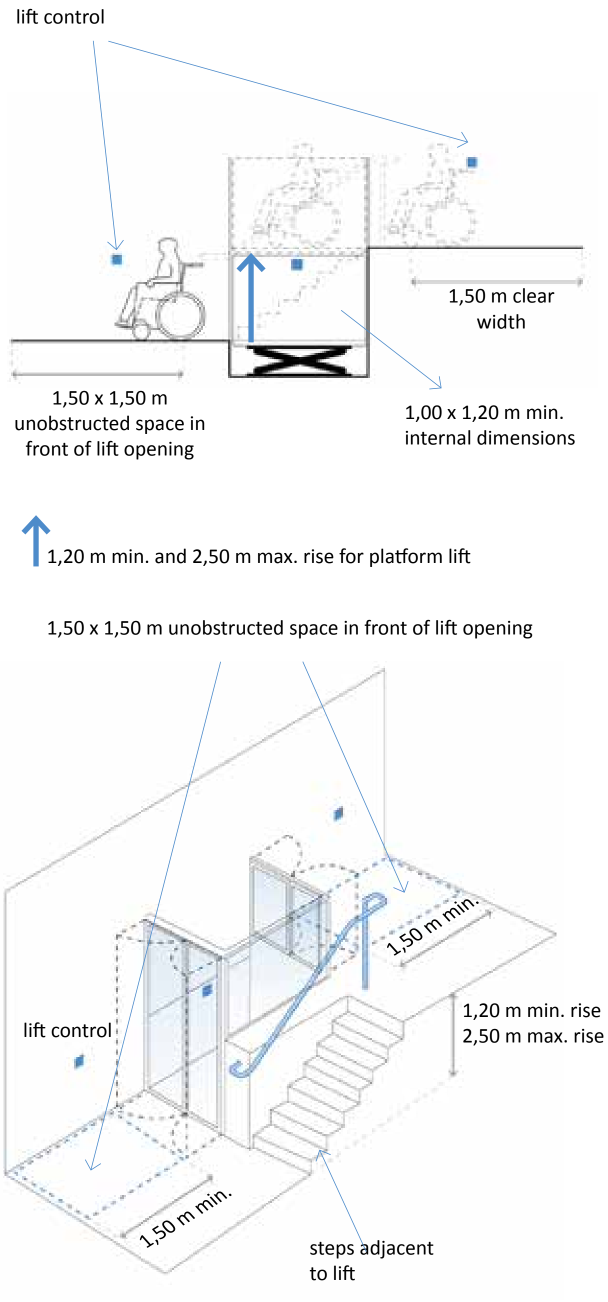


Figure 4.13: key dimensions of platform lifts, (source: building bulletin 91)

4.4 SANITARY FACILITIES

The provision of toilets and changing rooms depends on the size and type of educational organization as well as the number and needs of students with disabilities.

Sanitary facilities should devise between:
- facilities for staff and/or visitors;
- facilities for younger and older students in all-age educational institutions;
- toilet provision for boys and girls aged eight and above.

However, shared unisex wheelchair accessible toilets can be permitted.

Location

In determining numbers and location of accessible toilets, the travel distance to the sanitary facilities is an important consideration for the number of users of the building.

Accessible facilities should be carefully located around the building to avoid loss of curriculum time, prevent students wandering in the building and create supervision problems. Therefore, routes should be easy to navigate with suitable wayfinding.

A maximum travel distance of between 20 and 25 meters is recommended to the toilet spaces.

It is required that sanitary facilities can be reached from a circulation space. This is because some younger students (early primary age) may find enclosed toilet cubicles off the corridor scary. Substantially, for older students, hidden places for locating sanitary facilities should be avoided to prevent inappropriate behavior.

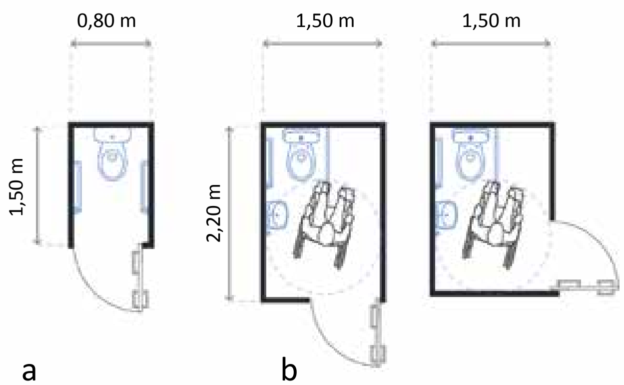
For students with severe impairments, having access to a toilet in the immediate vicinity of the classroom is required.

It is essential to provide a wheelchair accessible toilet in the entrance hall of buildings. Another one should be located within the vicinity of the drop-off zone for students who may need the toilet immediately on arrival to the building.

Various configurations

Educational buildings should provide:
- standard toilet cubicles;
- larger toilet cubicles for ambulant students who need more space to move around using mobility aids;
- wheelchair accessible toilets;
- specially equipped hygiene rooms for changing and showering of students with severe disabilities. (Figure 4.14 and 4.15).

Any combination of aforementioned toilet facilities is possible. They can be designed at different places in the plan or might be combined with each other. For example, one general toilet provision can incorporate standard toilet cubicles and ambulant disabled toilet cubicles in one toilet space. A wheelchair accessible toilet within each of the boys' and girls' toilet spaces or separately (as a unisex provision) are examples of other possible combinations (Figure 4.16).



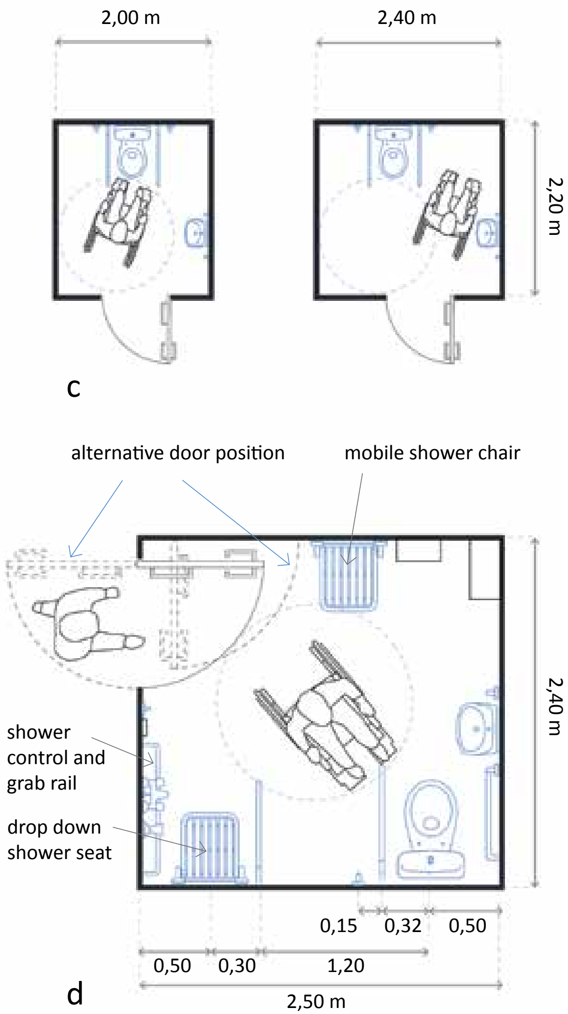


Figure 4.14: different configurations of accessible toilets:
(a) for ambulant disabled children;
(b) a corner layout for independent wheelchair users (allowing some assistance if required);
(c) a peninsular layout allowing staff to assist both sides;
(d) a small toilet and shower of 6m2.
It is recommended to provide some wheelchair accessible toilets for left handed and some for right handed transfer arrangements.

Figure 4.15: a corner layout accessible toilet with cubicles for dry changing

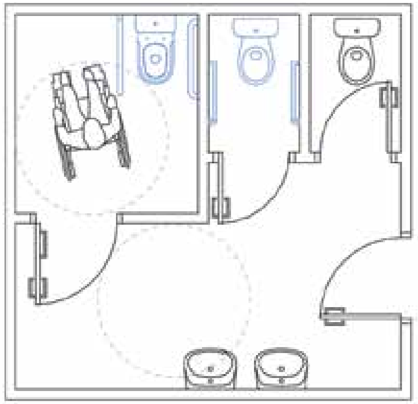


Figure 4.16: a wheelchair accessible toilet and an ambulant disabled toilet cubicle incorporated in general toilet facilities

Layout principles and key dimensions

The main considerations in designing toilets are to address aspects such as sufficient space to allow full-turn maneuvering of a wheelchair, appropriate height for fixtures and fittings and within easy reach of users (Figure 4.14 and 4.17).

Toilet doors must open outward for providing enough room within the toilet and for safety.

For wheelchair users, water closets should have a knee recess.

The layout, fixtures and fittings of the toilet should reflect the age of the students. Table 4.3 provides additional guidance for heights of water closets, toilet seat, grab bar and dispenser for the reach ranges of students age between 5 to 12 years.

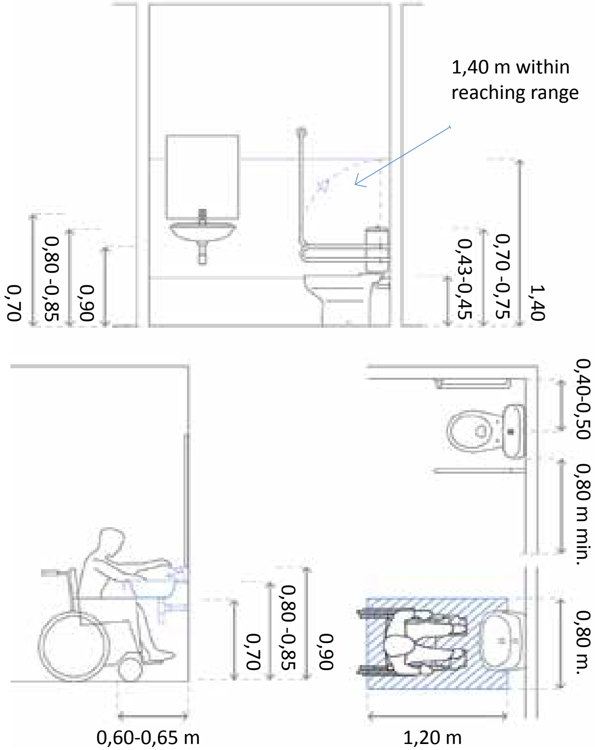


Figure 4.17: plans and sections showing key dimensions of water closet and toilet seat in accessible toilets for adult students

Table 4.3: Water closets and toilet compartments for the use of students between the age of 5 to 12 years old

	5 to 8 (years old)	9 to 12 (years old)
Water Closet Centerline	0,305 to 0,380 m (12 to 15 inches)	0,380 to 0,455 m (15 to 18 inches)
Toilet Seat Height	0,305 to 0,380 m (12 to 15 inches)	0,380 to 0,430 m (15 to 17 inches)
Grab Bar Height	0,510 to 0,635 m (20 to 25 inches)	0,635 to 0,685 m (25 to 27 inches)
Dispenser Height	0,355 to 0,430 m (14 to 17 inches)	0,430 to 0,485 m (17 to 19 inches)

4.5 BUILDING ELEMENTS

4.5.1 Doors

Doors should be carefully designed in order to give access and enclose areas rather than becoming barriers. All doors and doorways should not obstruct access of disabled students.

Wherever is possible, doors should be eliminated.

For exterior doors, a minimum clear opening width of 0,90m is required.

Interior doors should have at least a 0,80m opening clearance. However, a wider opening provides better access for a range of wheelchair users. For example, a clear door opening width of 0,90m on a corridor width of between 1,50m to 1,80m provides better access for students with a wheelchair.

When doors with a clear door opening width of 0,80m are on a narrow corridor (under 1,50m wide), a clear opening width of 1,00 to 1,10m or an extra side door leaf should be provided to allow the access of larger wheelchairs or equipment (Figure 4.18).

Accessible doors should have an appropriate strength to permit operation in a single motion with ease, particularly for students with limited power.

Door handles should be designed to provide an easily gripped/operated handle with only one hand. Lever handles are preferable to knob sets (Figure 4.19).

Handles should be contrasted visually against

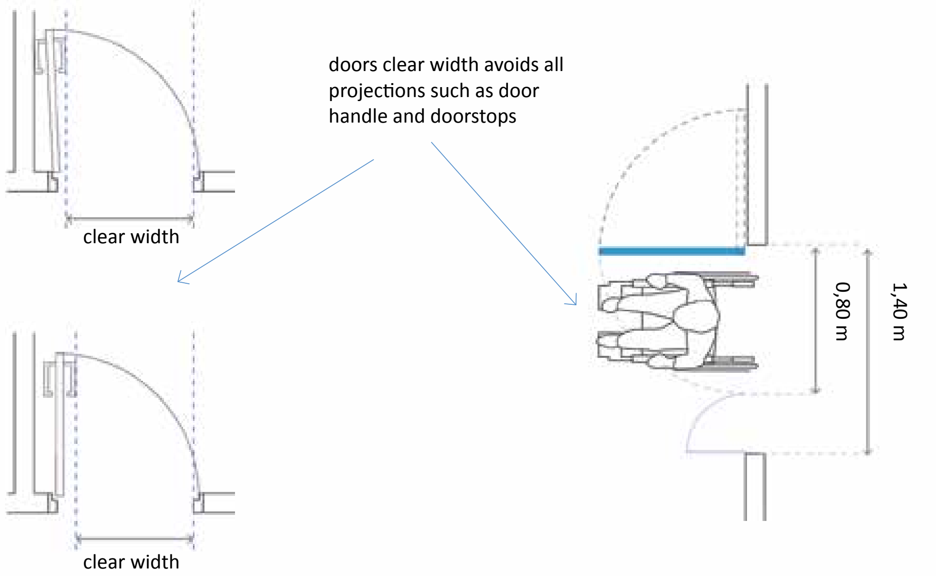


Figure 4.18: clear widths of doors

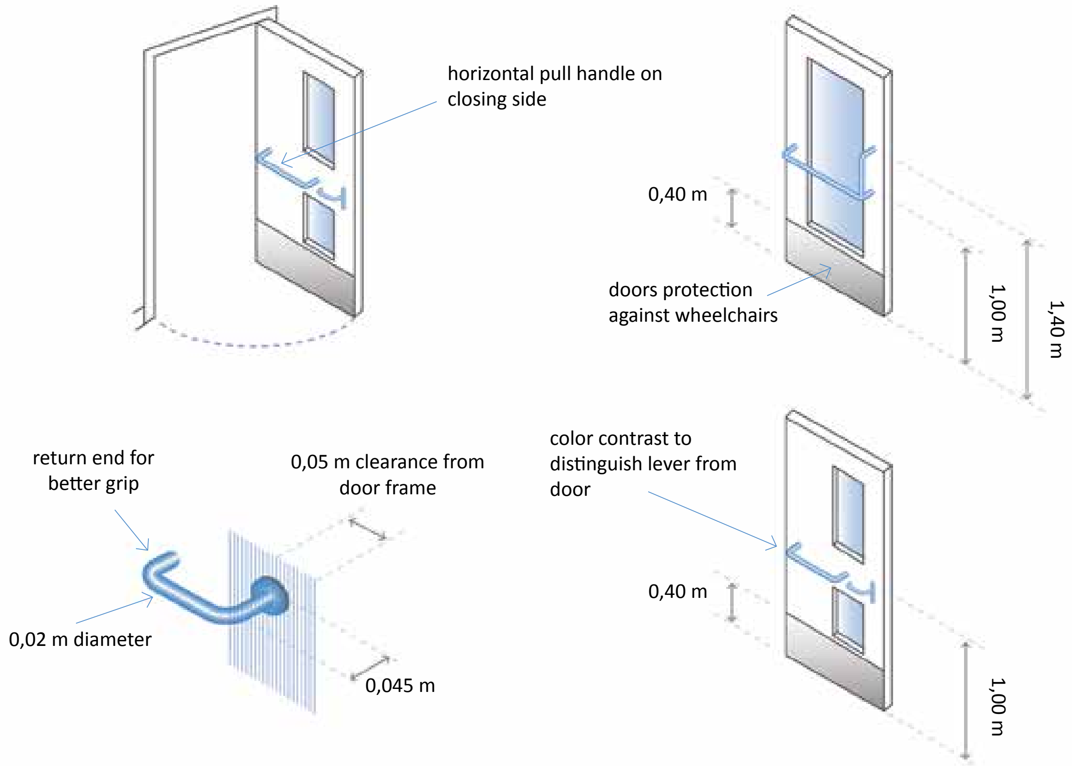


Figure 4.19: key dimensions and variations of door handles

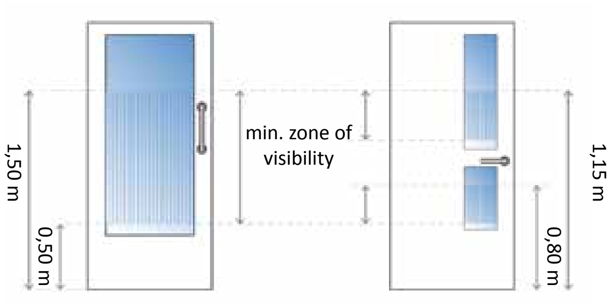


Figure 4.20: visibility requirements for doors and location of vision panels

Figure 4.22: glass panels next to the door to provide supervision from outside to the classroom (Bartimeus facility in the Netherlands)

Figure 4.21: manifestation on the glass (Source: Lancaster University)

their background.

Door protection (kick plate) with an effective height of 0,40m above floor level is required to protect doors from wheelchairs (Figure 4.19).

Doors should have a color contrast to aid visually impaired people to distinguish them from the surroundings (See also Figure 6.10 in § 6.4, subsection 6.4.3)

Doors must provide a good visibility on both sides of the door for those approaching it. This can be achieved by appropriate use of vision panels in the door.

The visible level on the doors is between 0,50m and 1,50m from the floor level. However, it is recommended to interrupt between 0,80m and 1,15m from the floor level to make a horizontal grab-rail possible (Figure 4.20).

The use of fully glazed doors is not recommended without any manifestation on it as it can be a hazard to visually impaired people.

Manifestation is a sign or a logo of at least 0,15m in length.

The manifestation on glass doors should be located at two levels 0,85m to 1,00m (seated eye level) and 1,40m to 1,60m (standing eye level). (See Figure 4.21 and also Figure 3.24).

Vision panels between 0,50m and 1,50m height in or next to the classroom doors is recommended to provide visibility for supervision (Figure 4.22).

Thresholds should be omitted (wherever possible) to prevent obstruction for disabled access as well as tripping hazard.

Where thresholds are used, they should be leveled with adjacent floor finishing surfaces.

For external doors, weather-stripping at the bottom of the door is preferred over thresholds to prevent the entry of water (drainage) and/or insects inside.

4.5.2 Windows and screens

To achieve the required amount of daylight within the building as well as allowing natural ventilation through the building, windows should be designed and located carefully on the building screen. (See also § 6.1 for *lightening*, § 6.2 for *acoustics* and § 6.3 for *ventilation*)

Low-level windows with safety glazing can also allow students to have a view out. However, there is a possibility that students become distracted with views from the outside.

Therefore, blinds should be used to:
- give flexibility to control the amount of light entering the space (based on activity taking place in the space);
- avoid distraction.

All window/glass fittings need to be without any sharp objects and prevent children from climbing out.

Internal glazed screens can be used to increase the penetration of natural light inside the building and to the areas that have no direct access to external windows.

Internal glazed screens make a passive supervision from the outside possible (See Figure 4.22 in subsection 4.5.1).

Window opening or any low projections in the circulation routes may create hazards (the same applies to doors opening). Figure 4.23 illustrates safety measures to define any opening projections (windows and doors) for visually impaired students walking outside.

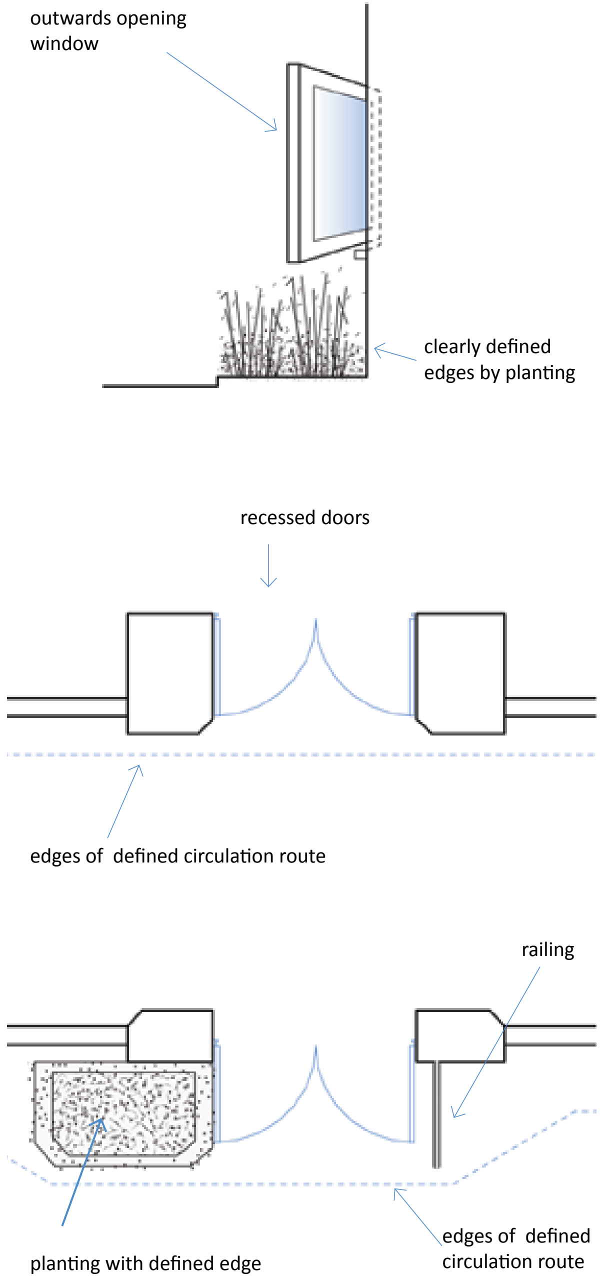


Figure 4.23: safety measures to define any window and door openings directly into circulation routes, (source: building bulletin 91)

DESIGNING LEARNING SPACES 5

LEARNING AND SOCIAL SPACES

CLASSROOMS
LIBRARY
MULTI-FUNCTIONAL SPACE
LECTURE AND CONFERENCE FACILITIES
OUTDOOR SPACES

FURNITURE

TABLES AND BENCHING
CHAIRS

ROOM LAYOUTS

CHAPTER 5: DESIGNING LEARNING SPACES

This chapter discusses essential functional programs and learning spaces required for an inclusive learning environment, while considering students in different ages and their needs within the mainstream educational facilities. Furthermore, it explains the requirements related to furniture and room layouts suitable for those learning environments.

5.1 LEARNING AND SOCIAL SPACES

The exact functional program and required learning space must be set out clearly in the program of requirements (brief) for any specific educational institute. The range of spaces depends on various aspects, such as available financial resources, an organization's curriculum and lastly the number and the needs of students with and without disabilities.

This report recommends a number of spaces that can be included in the design brief for educational facilities in South-Sudan. The recommended spaces[1] are not limited to:

- typical classrooms and teaching spaces that allow flexibility in learning and teaching;
- smaller rooms for small group work;
- larger rooms for practical activities;
- resource spaces (e.g. library and ICT facilities);
- large spaces for activities such as physical exercise and assembly;
- lecture and conference facilities;
- outdoor social and learning spaces.

Larger rooms should allow modification of the room to cellular and smaller spaces when needed.

Large spaces, such as conference facilities, assembly and physical exercise areas should be used as well by wider community in an appropriate time without interfering with students' educational schedule.

The aforementioned spaces should be supported by sufficient staff rooms and facilities, storage for personal belongings, mobility equipment (e.g. wheelchair), learning aids and resources and accessible sanitary facilities.

The following aspects should be considered when planning and designing for learning and social spaces:

Students with a disability may require more space than non-disabled students. For example, a student using a wheelchair or other mobility aids requires the space used by three non-disabled students.

Flexible schedule of the educational program may allow reduction in group size if required.

Flexible furniture, equipment and fittings should offer a variety of layouts to meet different needs and activities (e.g. for individual work or arranging different groupings, sitting in a circle, around a table).

Sufficient space around furnitures and equipment makes them accessible for those using mobility aids.

Learning spaces should be designed in an appropriate scale to offer effective teaching and supervision, to avoid distraction and confusion of students and to provide a good quality acoustic environment.

Learning spaces should be connected to a variety of outdoor spaces, noisy active/social places, as well as peaceful quite places for students.

5.1.1 Classrooms

The range of classrooms sizes in mainstream educational facilities may vary as follow[2]:

Small class bases (49–56m2 for up to 30 students): this classroom size is not recommended for new buildings as it does not offer full accessibility for students who use mobility aids. However, in a**n existing mainstream building**, it is possible to achieve an inclusive environment when some measures are taken, such as:

- clustering with larger classrooms when one or more students use mobility aids and require more space;
- storing coats, bags and resources nearby and outside the room;
- reducing fixed furniture to arrange the space as needed;
- decrease student numbers in the class to accommodate a student using a wheelchair or mobility aids.

1 The recommended spaces and provided guidelines are based on *Building Bulletin 102: Designing for disabled children and children with special educational needs, Guidance for mainstream and special schools* by the Department for Children, Schools and Families (DCSF), UK Government.

2 From *Building Bulletin 102: Designing for disabled children and children with special educational needs, Guidance for mainstream and special schools* by the Department for Children, Schools and Families (DCSF), UK Government.

Standard class bases (56–63m2 for up to 30 students): these rooms are large enough to accommodate one child using mobility aids and a wheelchair for all curricular activities. The provided space may allow access to some or all of the class for a disabled student, depending on the layout.

Large class bases (63–70m2 for up to 30 students): these classes provide full accessibility for one or more students using mobility aids and/or wheelchairs. This size is recommended as a base class size when there is more than one student with physical difficulties attending the class. Sufficient space for access and circulation for all of them, is provided this way.

5.1.2 Library

The size of the library depends on the school size, and may vary from 20 m^2 to 60 m^2. The design of libraries should enhance learning experiences by providing a quiet and calm space, as well as interactive areas with sufficient light, high air quality, a well-organized books and ICT resources. Shelves and computers should be located at an appropriate height for access of students including those seated on wheelchairs and younger students.

Where the library opens up to a noisier area and/or circulation area, there should be a goos signage for students passing alongside the library to avoid disruption. Substantially, measures such as security, fire and acoustics require attention in the design of libraries, just as with any other open plan spaces (Figure 5.1).

Figure 5.1: accessible library including quite and interactive spaces with an appropriate height of shelves and furniture

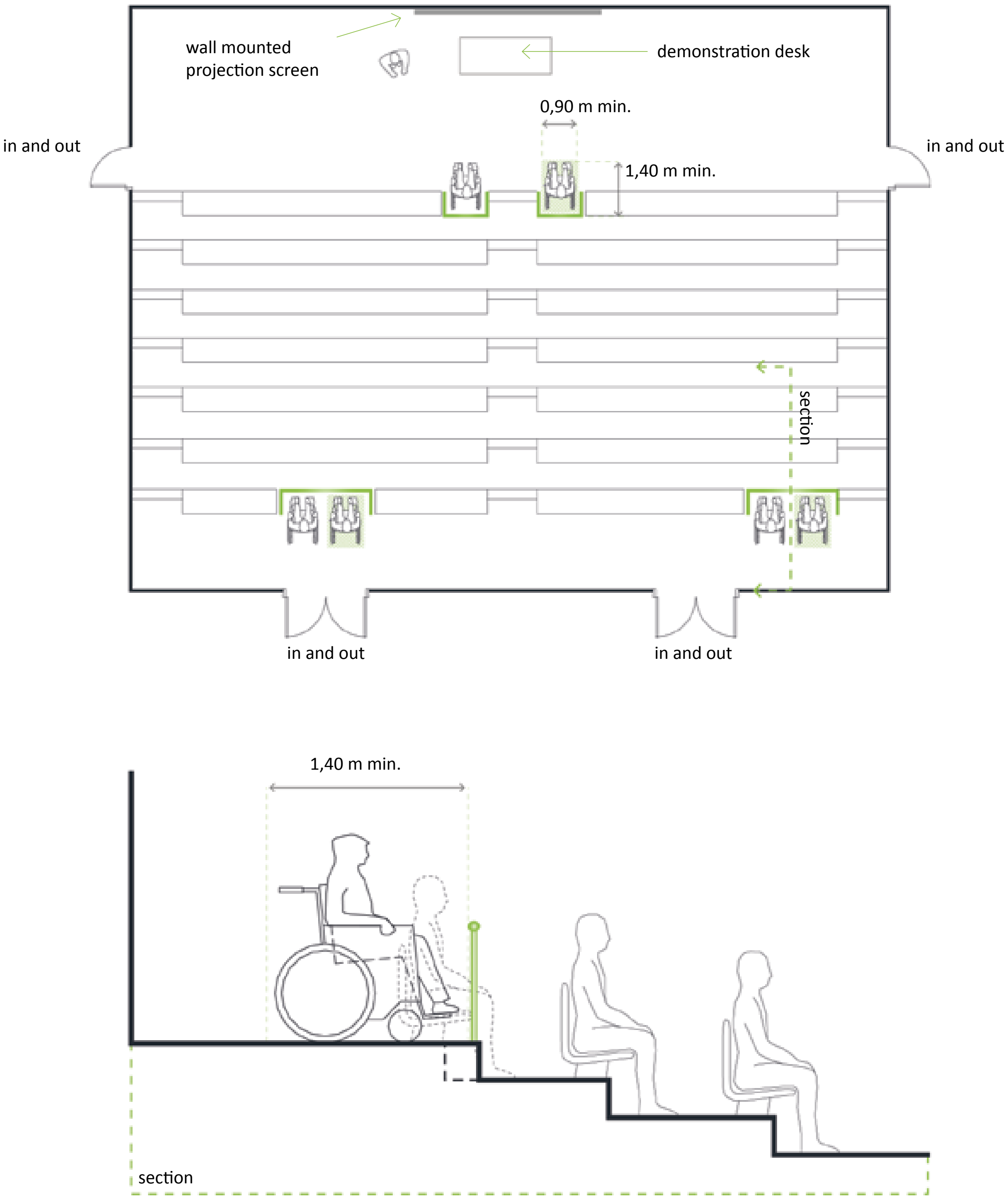
5.1.3 Multi-functional space

A multi-functional space of 140 m^2 to 180 m^2 for use, such as physical exercises, assembly and performance, is recommended. This is to create an ambient that allows students and teachers to come together as a whole community.

The following guidelines should be considered when designing a multi-functional space:
- it should be located centrally, such that it is easily accessible and that it reduces the travel distance of students from the teaching classes;
- a raised stage for performance use should have a ramp for disabled students;
- floor surface should be low glare;
- where physical exercises are located, an impact energy absorbing floor should be used (e.g sprung floor);
- light should be distributed evenly without causing glare and in a way that does not create edges;
- the difference between the darkest and lightest area should not be more than 50% since a higher number creates difficulties for visually impaired people;
- lighting bars and grids should be located at 6m clear height from the floor level when the space is used for sport as well;
- a good acoustic environment is necessary for a multi-functional space. The space should have effective sound separation and insulation (see § 6.2 for *acoustics*);
- fire safety issues in large spaces, where large numbers of people assemble together, are very critical. Emergency escape routes should be designed in accordance with guidelines of fire authorities of the country (Figure 5.2).

Figure 5.2: a variety of activities can take place in multi-functional spaces such as physical exercises, assemblies, group meetings and performances

Figure 5.3: key dimensions of wheelchair spaces allocated in a lecture and conference room



5.1.4 Lecture and conference facilities

Lectures and conference facilities (if provided in the building) should satisfy the needs of disabled students when using the space.

Sensory impaired students or students with mobility problems may need to be positioned from a particular side.

There should be some seats assigned for them in the front row to aid lip reading or seeing sign interpreters.

Lighting should be of a high quality which does not make it difficult to see the lecturer and the interpreter for sensory impaired students. (See § 6.1 for *lighting*)

Separate locations should be allocated for wheelchair users and students who have difficulties using chairs with fixed arms.

Extra space should be provided at the end of the rows and between the seat rows at the rear of a block for students that need to use more space.

A raised stage or podium (where used) should have a ramp for wheelchair users (Figure 5.3).

5.1.5 Outdoor spaces

Experiencing the outdoor environment is an important part for learning as well as leisure for all students in their early school years. This is of importance, especially for students with disabilities.

Outdoor spaces should be designed in a way that support the students' learning process, enrich teaching as well as be adventurous and an enjoyment for students. This can support students to develop their independence skills.

A variety of activities can be organized in the outdoor space, such as outdoor physical exercises and sport activities, informal social and recreational areas, as well as habitat and outdoor classroom areas. The latter may be used to help students with sensory and physical impairments to develop their learning, social and independence skills (Figure 5.4).

Activities such as outdoor recreational and informal social spaces are very crucial for adult students. However, outdoor spaces should be controlled for security and safety. Any conflicting issue such as the possibility to escape from the building or entry of strangers to the building area should be resolved in the design.

Figure 5.4: a range of outdoor spaces to enhance the learning experience of students in various ways

Figure 5.5: ergonomics data for adults with disabilities

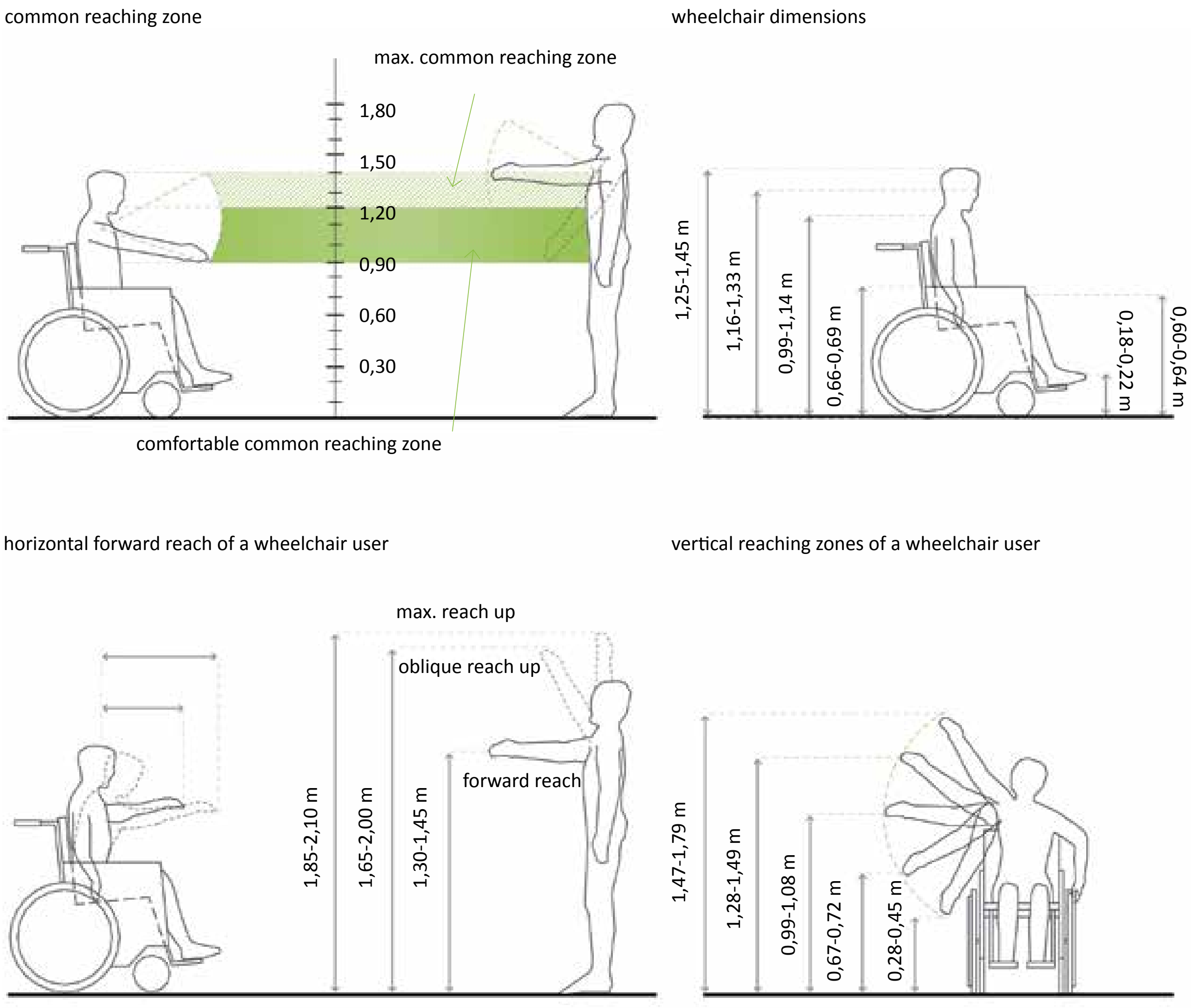


Table 5.1: reach ranges of students of different ages

Forward or Side Reach	5 to 8 (years old)	9 to 12 (years old)
High (maximum)	1,015 m (40 inches)	1,120 m (44 inches)
Low (minimum)	0,455 m (18 inches)	0,405 m (16 inches)

5.2 FURNITURE

Loose furniture that is easy to move around, gives greater flexibility than fixed ones. Loose furniture may be used for more than one purpose and creates place for a variety of activities and layouts.

Furniture must be designed in a way to meet the needs of the users, particularly students with impairments. This can be considered in a number of aspects such as ergonomics, stability, structural strength, durability, finishes and flammability.

Any specialist furniture and equipment must be assessed for safety risk to prevent any hazards for students.

Furniture's finishings should be smooth without any sharp edges or projections to avoid any harm being done, either by accident or inappropriate use.

Figure 5.5 illustrates the ergonomic data related to reaching zones for adults.

Table 5.1 indicates standards on reach ranges for students aged 5 to 12 years old. These specifications should be used as a guidance for designing building elements such as coat hooks, lockers, or operable parts for students under the age of 12. These dimensions apply to either forward or side reaches. Accessible furniture and operable parts designed for adult use or students over the age of 12 must be within the adult reach ranges provided in Figure 5.5.

5.2.1 Tables and benching

Working surfaces must be at appropriate reaching range for students in different ages as well as a suitable height for any special needs.

Tables and counters should have knee clearance for students with wheelchairs. Any counter should have a lowered section for the use from a seated position. (See also Figure 4.2 in § 4.1)

Depending on the available financial resources, it may be useful to provide adjustable height tables to meet various heights for a range of activities (Figure 5.6).

In order to provide posture support for students while seating and handwriting to improve comfort and concentration, the forward sloping tables are recommended to use. Tables having a forward sloping surface should be used with a forward sloping chair.

Tables should be wide and deep enough to provide sufficient room for learning and communication aids and within easy reach of students (Figure 5.7) (See also Figure 5.5 and Table 5.1 for various reaching ranges).

Tables and benching should provide enough room for an assistant to sit next to students (if needed).

Finishings should have appropriate color to provide visual contrast to the surroundings. Shiny surfaces and patterns are not recommended as it may reduce visibility.

Surfaces should not use acoustically reflective materials to aid creating a good acoustic environment.

Figure 5.6: wheelchair accessible table with an adjustable height

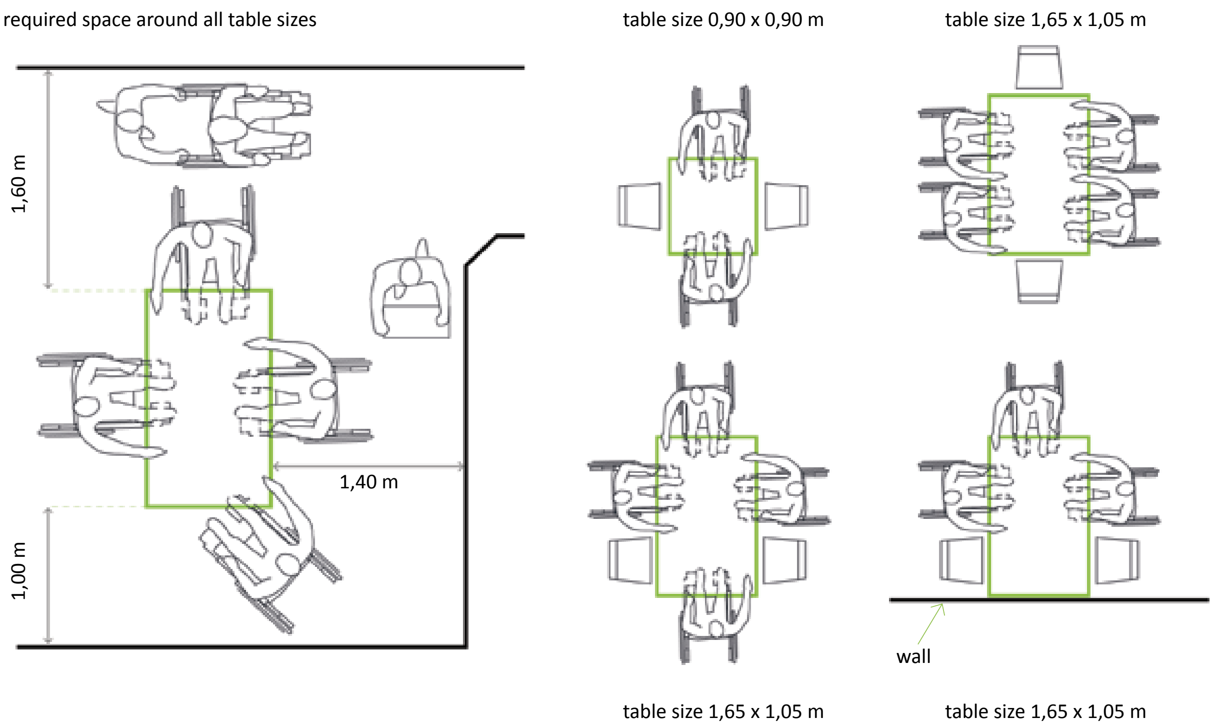
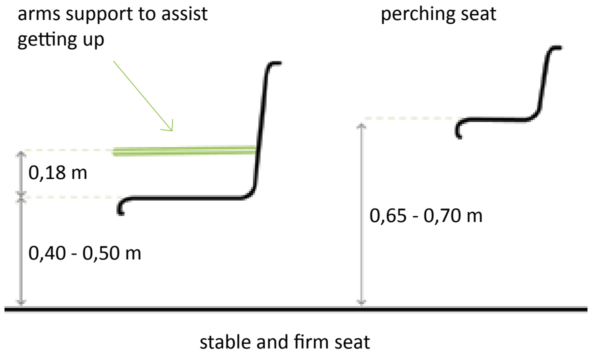


Figure 5.7: key dimensions of accessible tables, (source: building bulletin 91)

Figure 5.8: key dimensions of accessible chairs, (source: building bulletin 91)



5.2.2 Chairs

Chairs with an appropriate size, having full back support, are essential for all students. Chairs having foot rests may also aid students with disabilities.

Chairs and seatings (fixed or loose) must be stable.

Fixed seatings must be at 0,40-0,50m of height with arms for additional postural support and help withstanding (if needed). (Figure 5.8)

Chairs having forward sloping are recommended to be used with the corresponding sloping top tables.

5.3 ROOM LAYOUTS

Room layouts must reflect the needs of activities being carried out in the space, as well as the students' needs using the space (Figure 5.12 to 5.15).

Room layouts and the arrangements of tables, chairs, fixtures and fittings, should provide enough room for wheelchair maneuver space.

As mentioned previously, loose furniture is preferable over fixed ones to allow daily rearrangements to match diverse groupings, activities and needs. However, furniture should be placed carefully in a regular layout (rather than at random) to aid visually disabled students to understand the arrangements (Figure 5.9).

Room layouts should provide enough space for storage of mobility equipment, coat hooks and lockers. However, coat hooks and lockers with wheels underneath are preferable to be able to move them outside of the room (if needed). (Figure 5.10 and 5.11)

Figure 5.9: rearrangeable room layouts with loose furnitures (Bartimeus facility in the Netherlands)

Figure 5.10: movable coat hooks with wheels underneath to be kept outside the classrooms whenever is needed (Bartimeus facility in the Netherlands)

Figure 5.11: storage of mobility equipment outside the classroom (Bartimeus facility in the Netherlands)

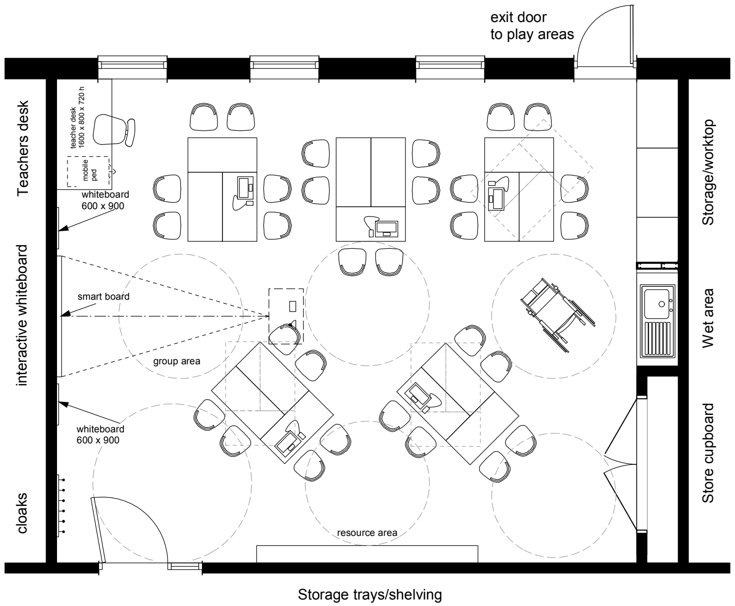


Figure 5.12: left top Typical floor plans of accessible mainstream class bases. It shows enough room at the entrance to access the whiteboard and space for maneuvering for wheelchair users. It should be mentioned that fixed tables located in the middle of the space may restrict flexibility and the use of the space. Therefore, fixed fittings should be planned carefully with loose modular tables to allow changes in the room layout. (Source: *Building Bulletin 102*, DCSF)

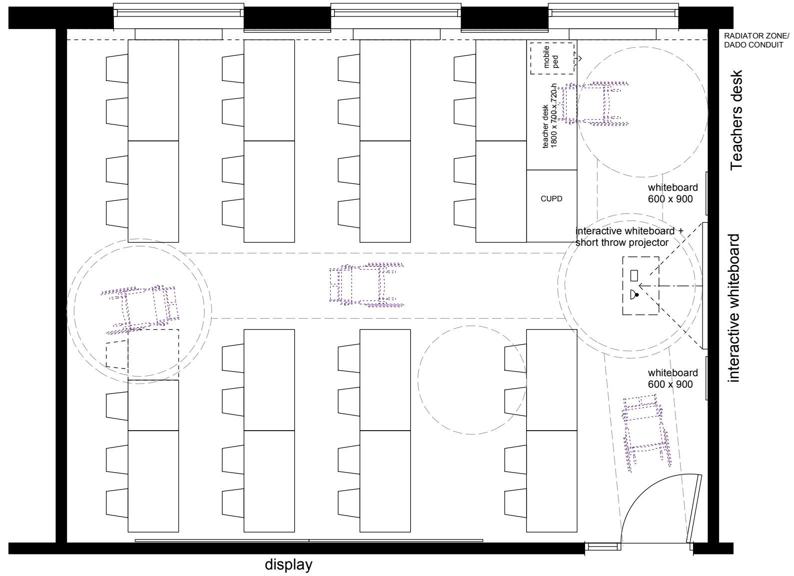


Figure 5.13: floor plan of an accessible mainstream class of around 63 m^2 having access for wheelchair users. It shows enough maneuver space at the entrance, between space to move to the teacher's table a whiteboard, an accessible table with enough space for a teaching assistant alongside and also the possibility of a teacher using a wheelchair in the class. (Source: *Building Bulletin 102*, DCSF)

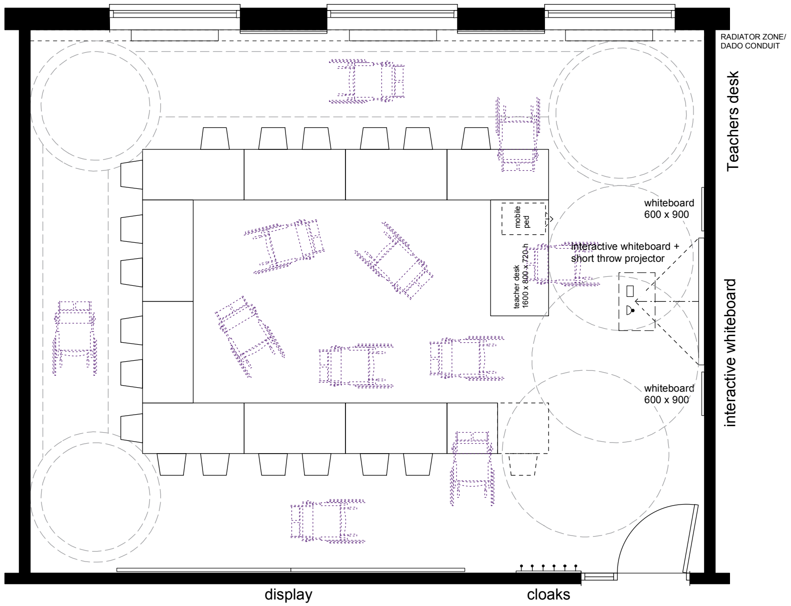


Figure 5.14: floor plan of accessible mainstream teaching space for 18 to 20 students of around 70 m^2 having access for a high number of students with disabilities. It shows a large base classroom which allows full accessibility to all parts of the space for students and teachers using wheelchairs. (Source: *Building Bulletin 102*, DCSF)

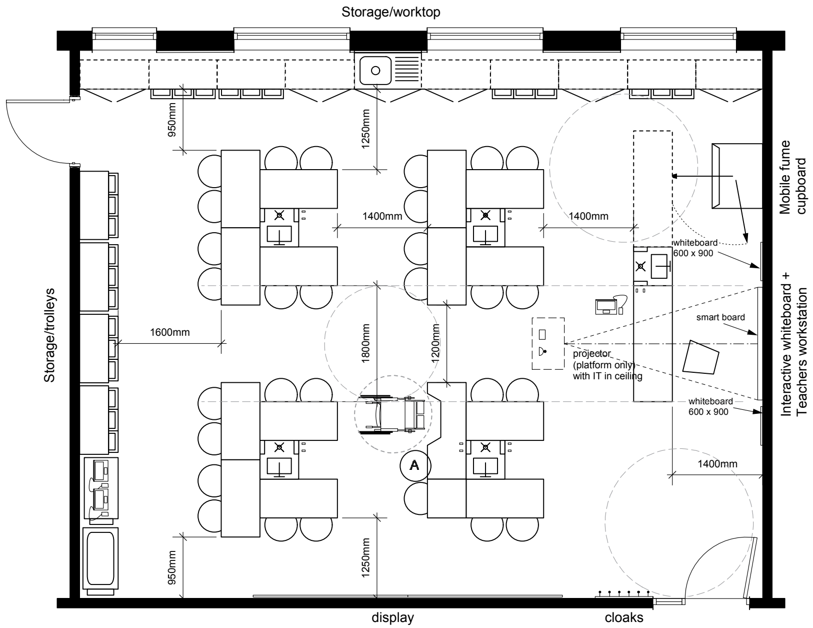


Figure 5.15: floor plan of accessible mainstream science laboratory for up to 30 students of around 90 m^2 having access for one wheelchair user to access all facilities such as perimeter bench, demonstration bench and whiteboard. (Source: *Building Bulletin 102*, DCSF)

SENSORY AWARENESS AND ENVIRONMENTAL COMFORT 6

LIGHTING
DAY LIGHT
ARTIFICIAL LIGHT

ACOUSTICS

ENVIRONMENTAL COMFORT
THERMAL COMFORT
VENTILATION

SENSORY WAYFINDING
SIGNAGE
COLOR (TONAL CONTRAST)
TACTILE MARKING

CHAPTER 6: SENSORY AWARENESS AND ENVIRONMENTAL COMFORT

A person with sensory impairments, such as poor sight and hearing loss, experiences the surroundings very different. Considering the needs of people with sensory disabilities, an adequate provision of lighting, signs, visual contrast, good acoustics, environmental comfort and well-being, is strongly required. This section emphasizes on the fact that when sensory aspects such as visual contrast, hearing and touching, integrate into design, it creates a better and more convenient space to use and learn for students. This is not only to help students with different kinds of impairments to orient themselves better, but also to have a positive impact on productivity and learning of all students. This way the designer creates a building that is comfortable and easy to use rather than one that is confusing and hazardous.

6.1 LIGHTING

Lighting may assist students with sensory disabilities, or who may lack comprehension, by enhancing the impact of variation in color and texture and providing visual cues.

Good lighting is essential for people with visual disabilities to enhance their sight for orientation and using signage and wayfinding.

Good lighting is equally important for those with hearing disabilities who need to be able to lipread or see sign interpreters.

Lighting should avoid glare, silhouetting, reflections, shadows and any other interference that causes visual confusion (Figure 6.1).

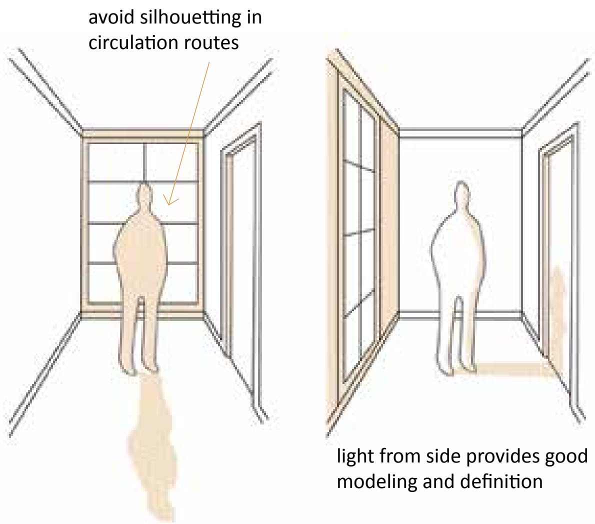


Figure 6.1: lighting should avoid glare and silhouetting, (source: building bulletin 91)

Shiny and glossy walls as well as floor surfaces should be avoided as it reflects light and causes a poor visual condition.

The building’s orientation and any natural shading on the site, should be carefully studied, including the location of spaces that generate the most heat, and the need and detailing of shading devices.[1]

Lighting requirements should meet the needs of individuals as well as the task on which they are working.

6.1.1 Daylight

Daylight is important for all students, especially for students with disabilities to benefit from a connection to the outdoors space and a view out. However, the amount of light entering the space should be controlled to avoid glare from or reflected sunlight which causes visual difficulties for those with sensory disabilities.

Figure 6.2: using panels in front of the light to distribute a very sharp light close the ramp to provides a sufficient light in the space without irritating the eyes

Blinds and other solar controls must be used to control sunlight or daylight levels for comfort or better visibility (particularly for low sunlight in winters).

A minimum average daylight factor of 2% is considered adequate for most areas in mainstream educational facilities . The minimum average daylight factor of 4-5% is recommended for educational facilities with a large number of students with sensory disabilities. However, under-lit areas furthest from windows should be avoided and an acceptable uniformity ratio of light is required to maintain.[2]

6.1.2 Artificial light

Light fittings should be low glare, avoiding any

1 In a hot weather extended roof is recommended. This is because of shadow creation and avoidance of the direct sun light to the room.

2 The recommended daylight factor are extracted from *Building Bulletin 102: Designing for disabled children and children with special educational needs, Guidance for mainstream and special schools* by the Department for Children, Schools and Families (DCSF), UK Government.

flicker and unwanted noise.

It may be necessary to avoid visible light sources as they are too bright for eyes and spread the light near the light sources (Figure 6.2).

Uplighting, set above standing eye level, may be used to provide a glare-free environment.

Depending on the space to be lit, the luminance (or general lighting level) should be:[3]
- entrances (halls, lobbies and waiting rooms):
  300 lux at 20 cm level;
- circulations (ramps, stairs, corridors and lifts):
  100-200 lux at 20 cm level;
- toilets and changing rooms:
  100-150 lux at 20 cm level;
- classrooms:
  500 lux at 75 cm level;
- staff offices:
  500 lux at 75 cm level.

6.2 ACOUSTICS

Noise distractions and high ambient noise levels are poor acoustic conditions and must be avoided when there are students with sensory impairments and/or communication difficulties. Students with sensory impairments require a good acoustic environment with an appropriate sound insulation for their access to learning as well as navigation cues in the space.

Spaces with long reverberation times, when using finishing surfaces that are acoustically highly reflective (such as hard dense surfaces), must be avoided as they are not suitable for many types of students' needs. For example, students using hearing aids may find the noise painful as it becomes amplified by their hearing aids.

Short reverberation times (0,4 - 0,6 seconds) are advised as a pleasant reverberation times for classrooms (no echoes) which allow students to hear and concentrate better.[4] However, in any specific building, the design and volume of the room, the function of the room, the openings in the room (e.g. windows) and the material with different sound absorption used for finishings in the room, can influence the acoustic conditions. Therefore, it is crucial for the well-being and convenience of students, to measure and determine the noise level and reverberation times with a specialist advice from an acoustician.

The ability of a surface to absorb sound (sound absorption rate) should be measured carefully to minimize the reflection of sound energy back into the space.

Sound absorbing properties are classified in five categories of Class A to Class E. Class A offers the highest level of sound absorption[5]. (See Figure 6.3 and Table 6.1)

Soft, porous and pliable materials are considered good acoustic insulators with a high absorption rate (αω). While hard, dense impenetrable materials increase echo and sound reverberation and may create acoustic confusion. (See Table 6.2)

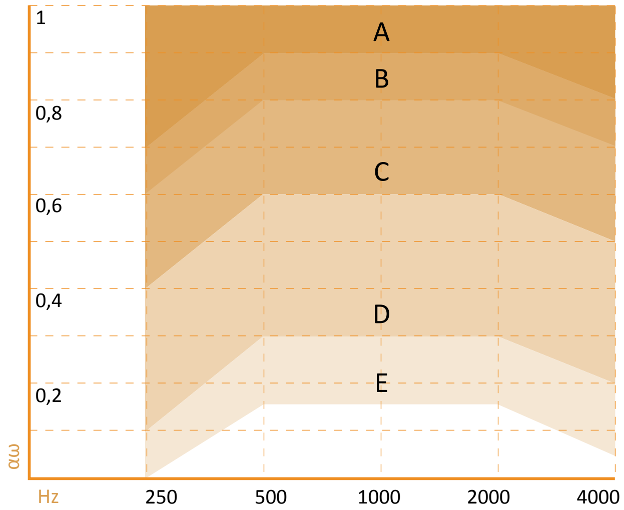


Figure 6.3: Sound absorption classes and sound absorption rate (αω) in frequency between 250 Hz to 4000 Hz

SOUND ABSORPTION CLASS	SOUND ABSORPTION COEFFICIENTS (αω)
A	1,00-0,95-0,90
B	0,85-0,80
C	0,75-0,70-0,65-0,60
D	0,55-0,50-0,45-0,40-0,35-0,30
E	0,25-0,20-0,15
Not classified	0,10-0,05-0,00

Table 6.1: Sound absorption classes and sound absorption rate (αω)

In both **new-built** and **existing buildings,** the installation of acoustic ceiling panels or acoustic wall panels may assist to decrease the reverberation times and thus eliminate any echoes (Figure 6.4).

To achieve an acoustic environment that reduces

3 The luminance standards are based on Dutch standards of NEN 3087 (de Nederlandse norm) and general European lighting standards NEN-EN 12464-1 in the book of Architectuur door andere ogen by Atelier Made and Stichting Zilvergrijs en Bartiméus, 2012, The Netherlands.

4 From the book of *Architecture door andere ogen*, by Atelier Made and Stichting Zilvergrijs en Bartiméus, 2012, The Netherlands.

5 Refer to EN ISO 11654, *Acoustics - Sound absorbers for use in buildings - Rating of sound absorption,* retrieved from http://www.iso.org/iso/catalogue_detail.htm?csnumber=19583

Table 6.2: Sound absorption coefficients (αω) for different materials

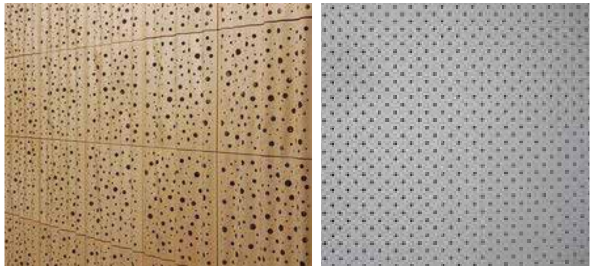
MATERIALS	SOUND ABSORPTION COEFFICIENTS (αω)					
Wall/ceiling	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
Brick, unglazed	.03	.03	.03	.04	.05	.07
Brick, unglazed, painted	.01	.01	.02	.02	.02	.03
Carpet, heavy, on concrete	.02	.06	.14	.37	.60	.65
Concrete Block, light, porous	.36	.44	.31	.29	.39	.25
Concrete Block, dense, painted	.10	.05	.06	.07	.09	.08
Plaster, gypsum or lime, smooth finish on tile or brick	.013	.015	.02	.03	.04	.05
Plaster, gypsum or lime, rough finish on lath	.14	.10	.06	.05	.04	.03
Plaster,gypsum or lime,smooth finish on lath	.14	.10	.06	.04	.04	.03
Plywood Paneling, 3/8-inch thick	.28	.22	.17	.09	.10	.11
Floor						
Concrete or Terrazzo	.01	.01	.015	.02	.02	.02
Linoleum, asphalt, rubber, or cork tile on concrete	.02	.03	.03	.03	.03	.02
Wood	.15	.11	.10	.07	.06	.07
Wood parquet in asphalt on concrete	.04	.04	.07	.06	.06	.07
Glass						
Large panes of heavy plate glass	.18	.06	.04	.03	.02	.02
Ordinary window glass	.35	.25	.18	.12	.07	.04
Marble or glazed tile	.01	.01	.01	.01	.02	.02
Other surfaces						
Water surface, as in a swimming pool	.008	.008	.013	0.15	.020	0.25
Air, Sabins per 1000 cubic feet	.09	.20	.49	1.20	2.90	7.40
Open doors and windows	1.00	1.00	1.00	1.00	1.00	1.00
Absorption of Seats and Audience (Sabins per square foot of seating area or per unit)						
Chairs, metal or wood seats, each, unoccupied	.15	.19	.22	.39	.38	.30
People in a room, per person, (do not use for auditorium calculations	2.00	3.00	4.00	5.00	5.00	4.00
Audience, seated in upholstered seats, per square foot of floor area, for auditorium calculations	.60	.74	.88	.96	.93	.85

Figure 6.4: reduces sound reverberation and reflection by using: acoustic wall panels (a); acoustic ceiling panels (b); acoustic baffles (c); porous pattern for acoustic panels (d)

a

b

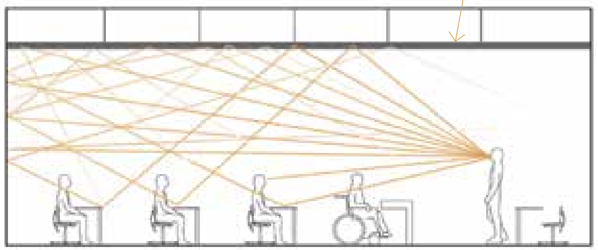
c



d

absorbing materials reduce the sound

reflecting materials



reflecting materials amplify the sound

sound transmission between rooms

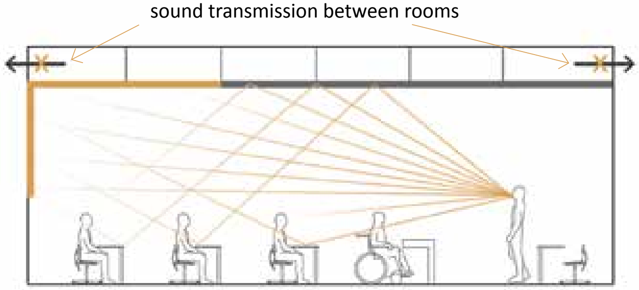


Figure 6.5: the installation of absorbent materials in classrooms used to reduce noise levels and minimize reflection. Appropriate use of reflecting surfaces are very important for reinforcing the voice of the teacher/lecturer. Materials with high sound absorption rate reduce noise from adjacent rooms.(Source: Knauf AMF)

sound reverberation and reflection design should considers to use (Figure 6.5):

- finishing materials and sound insulation with high sound absorption on the wall/ceiling;
- acoustic ceiling panels, acoustic wall panels or acoustic baffles for large and open spaces such as multi-functional halls;
- appropriate forms and volumes for designing learning spaces.[6]

6.3 ENVIRONMENTAL COMFORT

The average yearly temperature in South Sudan[7] is around 35˚C. For the comfort and well-being of students, particularly for students with disabilities (who may be more sensitive and have complex health needs), the environmental condition in the building should be controlled.

6.3.1 Thermal comfort

One of the options to enhance the thermal comfort inside the building is to avoid indoor overheating caused by solar radiation during the summer while allowing it to enter the building during winter. There are some factors that can reduce the solar heat gain in the building. For instance, appropriate thermal insulation, size and orientation of windows, and the use of shading devices.

Another option, to increase the thermal comfort inside spaces, can be the use of natural ventilation. Next section explains this more explicit.

6 In a warm and humid climate such as South Sudan, if the building plan is designed very open, the form might allow the sound to exit the rooms easily. As a result, it is not necessary for a special design of e.g. the ceilings.

7 The average high temperature in Juba, the capital and largest city in South Sudan, from *Geography of South Sudan*, by Amanda Briney, 2014, retrieved from: http://geography.about.com/od/sudanmaps/a/south-sudan-geography.htm

6.3.2 Ventilation

Fresh air and effective ventilation is essential for all learning spaces. High levels of carbon dioxide in stale air may affect the concentration of students and causes drowsiness, particularly with students with special needs.

As mentioned previously, to enhance the thermal comfort inside the building, in the warm humid climate of South Sudan, it is important to use natural ventilation.

By providing cross ventilation, the heat can be carried away from the building and from the human body. Also it balances the indoor air quality and the level of the oxygen.

Maximizing cross ventilation can be possible by, for example, the forms of the building next to each other, orientation, size and position of openings (e.g. windows). There are other design features to aid natural (cross) ventilation through the building such as putting fresh air inlets near the floor level and using ceiling fans.

However, special attention should be given to the ventilation design as it should not compromise acoustic performance in the learning environment.

6.4 SENSORY WAYFINDING

Wayfinding and signage are invaluable for people with various impairments such as physical and sensory impairments and cognitive disabilities.

Lighting, acoustics and sound, color, texture, as well as landmark features such as seating, plants or other especial elements can aid people to orientate themselves in and outside the building. For example, visual impaired people may use various non-visual signals such as noise level and smell for recognizing a space.

Sensory wayfinding should be carefully designed and placed and should be enhanced by:

- using signage or symbols at junctions, in corridors and besides each room to indicate direction or position;
- using contrasting colors or tones on walls to define routes;
-using tactile walking surface indicators[8] to define circulation routes (e.g. contrasting textures or floor finishes)
- using voice signals which react to movement or warn hazards.

6.4.1 Signage

Signs should be clear and legible. The effectiveness of signage depends on:

- the consistence during the entire route without any gaps in signage on the long routes to inform as well as reassure;
- the clearly visibility, it should be well lit and shiny or bright surfaces should be avoided;
- the use of upper and lower case lettering and contrasting colors against their backgrounds;
- the differentiation between signs that are used for direction and those that show arrival;
- the identification at eye level and should be located, i.e. between 1,40-1,60m so that everyone can see it;
- the provision where required (e.g. on classroom doors) within reach and should have embossed tactile lettering, braille or other tactile information to aid students with visual disabilities (Figure 6.6).

8 Refers to ISO-Standards (ISO 23599:2012), *Assistive products for blind and vision-impaired persons: Tactile walking surface indicators (TWSI).*

Figure 6.6: the name of the classroom has used embossed tactile lettering and braille for students with visual disabilities

Figure 6.7 next page shows critical positions for signs, symbol and controls.

6.4.2 Color (tonal contrast)

The well thought use of color is a very crucial aspect in designing the learning spaces, particularly for students with visual impairments.

Designing with color should be considered in relation to light levels, visibility, psychological effect and maintenance.

The ability to identify differences between colors is strongly correlated to the amount of light that the colored surface reflects.

In general dark colors absorb the light and the light colors reflect the light. For example, visually impaired people may not be able to recognize

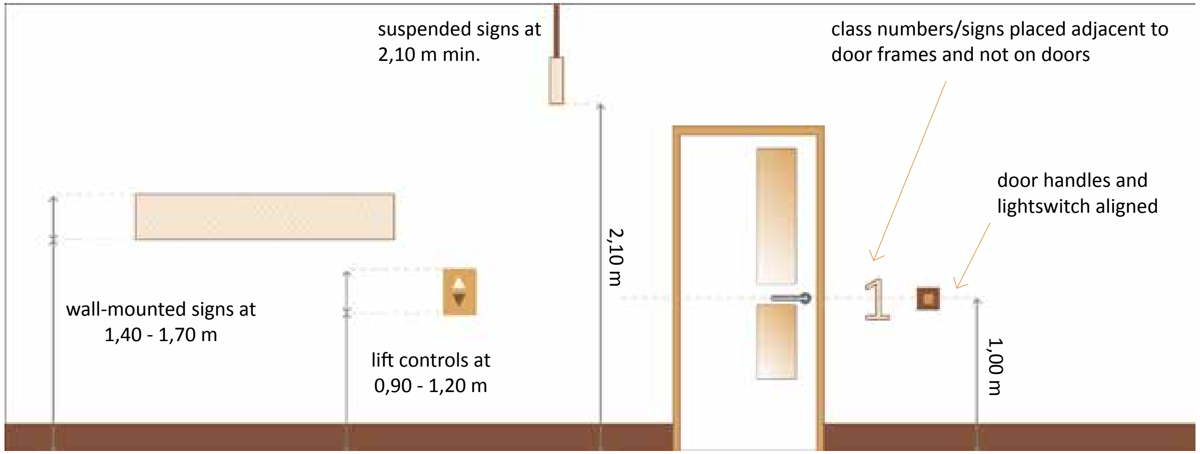


Figure 6.7: critical positions for signs, symbol and controls

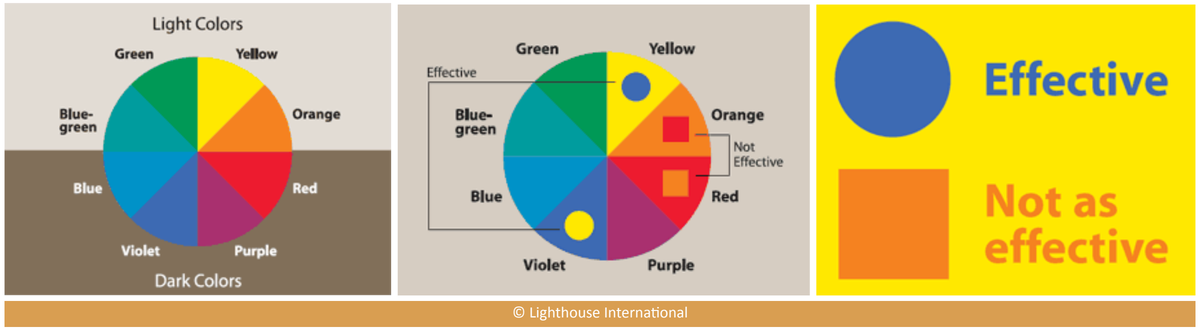


Figure 6.8: effective color selection scheme when designing for students with visual impairments, (source: Lighthouse International)

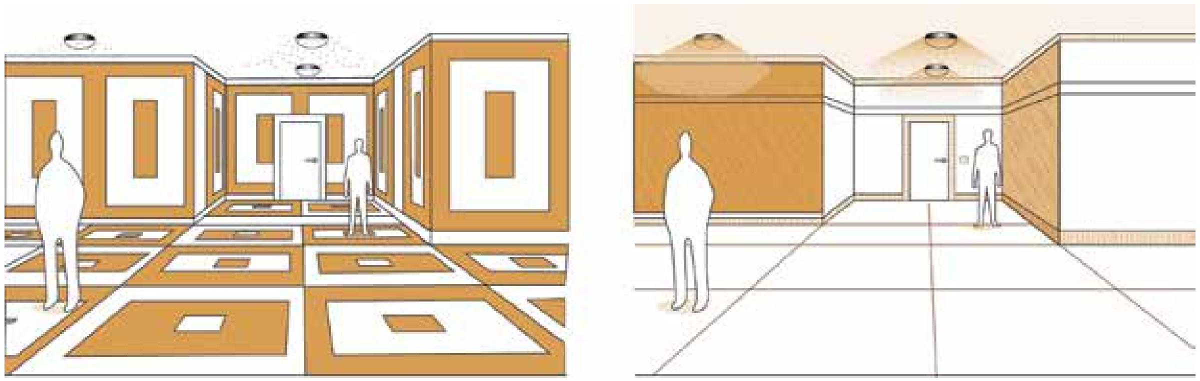

a
b

Figure 6.9: color contrast:
busy pattern and use of color contrast within each plane on wall and floor surfaces causes visual confusion and must be avoided(a); color contrast and layers are used in floor and wall planes to aid distinguishing between different objects and spaces(b), (source: building bulletin 91)

blue color next to red, but are able to recognize yellow from blue (Figure 6.8).

However, the combination of contrasting hues from colors next to each other in the hue circle should be avoided, particularly when the colors do not contrast sharply in lightness (Figure 6.8).[9]

Key points in relation to the use of colors are:
- a soft and delicate shade of a color is recommended to be used as it is soothing;
- a bright surface can be glaring against a dark background and reduce visibility (e.g. a window in a dark wall);
- busy patterns and bright colors in large spaces can create confusion (Figure 6.9);
- using contrast and layering colors define areas and objects better for visually impaired people (Figure 6.9);
- color and tonal contrast on architectural features can be used to identify objects (e.g. light switches) or warn possible hazards (e.g. on nosing of stairs);
- lastly using different colors (e.g. on doors) can be used as a code to identify spaces (See Figure 6.10 page 52).

6.4.3 Tactile marking

Tactile markings should be used to warn students who are visually impaired when they are approaching a hazardous situation (e.g. a ramp, stairs, fence, etc.). They can also be used to provide informative cues and to identify different areas such as circulation routes, staying areas and arrival points (Figure 6.11 page 52).

9 From Lighthouse International (2014) by Aries Ardit: *Effective Color Contrast, Designing for People with Partial Sight and Color Deficiencies*, Retrieved from http://www.lighthouse.org/accessibility/design/accessible-print-design/effective-color-contrast

The tactile walking surface indicators with raised tactile profiles and a high tonal contrast at the top and bottom of the ramp and stairs (as well as nosings with marking strips), should be used to warn people with visual impairments for changes in level and reduce potential hazards. Figure 6.12 shows the variations in the textures that can be used to make a distinction between change of level, attention or guiding patterns.

Tactile marking can be an invaluable aid to students that orient themselves in and outside building as well as providing safety in a potential hazardous area. The use of tactile indicators is strongly recommended as they can be easily incorporated into new or **existing buildings** to aid visually impaired students.

Figure 6.10: the doors are painted in a color that contrasts with the wall to facilitate its identification by students with visual impairments. Different spaces have different colors that are easily identified by students.
For example
Purple: sanitary facilities;
Red: classrooms;
Yellow: recreational activities (sport hall)
White: selected deliberately to not be identified by students as the room is not meant to be used by students. (Bartimeus facility in the Netherlands)

Figure6.11: the wooden strips aid students to follow the direction. The contrasting triangular items indicates the continuity of the movement, while the red square elements inform students that there is a door/opening to another space. (Bartimeus facility in the Netherlands)

Figure 6.12:Tactile tiling of two main patterns:
attention patterns (a);
guiding pattern (guide strips) (b);
range of uses of tactile marking on the floor to aid identifying travel routes, hazard and alternative routes (c);
guide strip ridge profile should be parallel to the main direction of movement and should be flush with the top layer of the adjacent road surface so as not to hinder people with mobility problems (d).

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