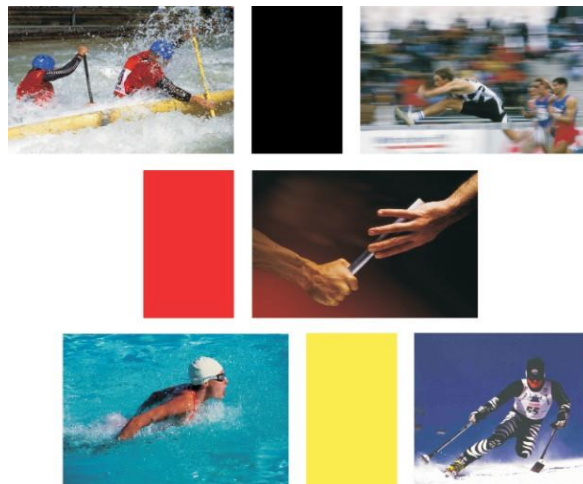




Bundesinstitut  
für Sportwissenschaft

# BISp-Planning Guideline

## *Architectural Guidelines for Paralympic Sport Facilities*



*Status: October 2010*

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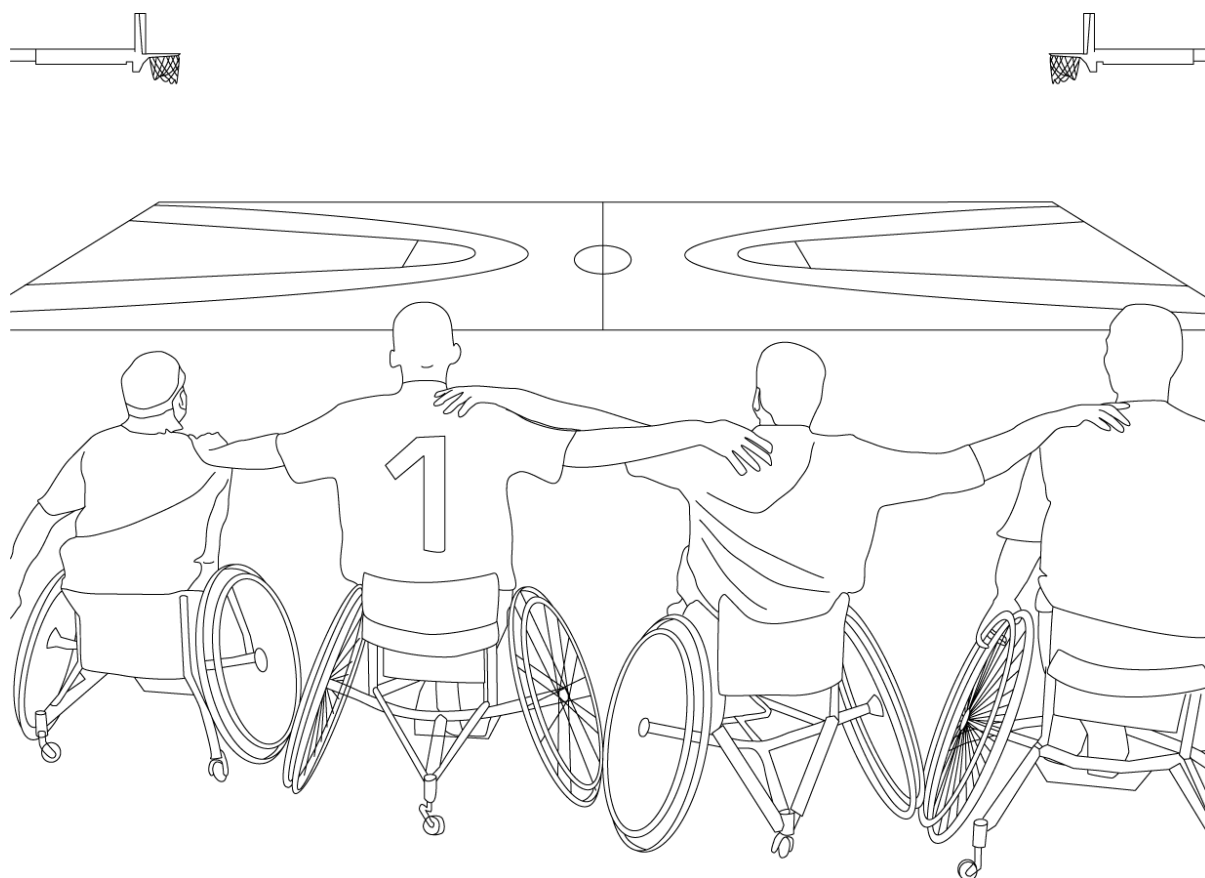
The planning guideline, as part of the series of publications concerning sports facilities and sports equipment issued by the Federal Institute of Sport Science (BISp), contains solely the recommendations. The building regulations of the federal states and the currently applicable DIN standards must be followed in any case. This planning guideline is not automatically adapted to the currently applicable DIN standards.

Status: October 2010

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Planning Guideline

ARCHITECTURAL GUIDELINES FOR PARALYMPIC SPORT FACILITIES





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## Preliminary note

The present planning guideline concerning the conditions to be met by constructions for the Paralympic sport contains the findings of the research project bearing the same title. The project was promoted by the Federal Institute of Sport Science (*Bundesinstitut für Sportwissenschaft - BISp*) in Bonn, Germany. An interdisciplinary working group worked on the project during the years 2007 to 2009 under the direction of Prof. Dr.-Ing. P. Schmieg of the Technical University of Dresden, Chair for Social and Health Care Constructions, in which the Institute for Rehabilitation Sports, Sports Therapy and Sports for the Disabled at the University of Leipzig and *blue concept*, the European Institute for Holistic Barrier-free Habitats also participated.

This planning guideline is intended to help architects and planners and all such professional groups dealing with sports for people with disabilities in its practical application. The extensive findings of the research project, details of the applied methodology, explanations about various impairments and classifications of athletes with disabilities as well as references to the sources used are found in the publication of the research project; it was published in 2010 by Sports Publishing Strauss in Cologne, under ISBN 978-3-86884-512-9.

The project focused on the following representative types of sports: Wheelchair basketball and Rugby, Sitting volleyball, Goalball, Swimming, Athletics and Ice Sledge Hockey. In order to derive appropriate design criteria, first the current state of knowledge concerning sports for people with disabilities was discussed at various levels (elite sports of Paralympics, recreational and leisure and school and rehabilitation sports). Subsequently, the research team analysed the existing sports facilities to examine if the principles of barrier-free construction are being implemented (in accordance with DIN

18024 and 18025). The user needs of athletes, coaches, helpers and spectators were examined on the basis of guided interviews and questionnaires. It was evident from the results that there are major constructional and structural deficiencies in sports for people with disabilities. By synthesising the comparative analyses and surveys, including the know-how of the sports science and its functional relationship to sports, it was possible to identify criteria for future construction or remodelling of sports facilities. These are outlined in the present planning guideline in a brief and application-oriented form.



## 1. Introduction

For several years, the field of sports for people with disabilities has been steadily experiencing professionalization and is drawing more public attention. In many disciplines, the records achieved by athletes with disabilities have come now close to those of sports persons without disabilities - a fact that contributes to its enhanced attractiveness for spectators. On the one hand, this development is the result of a wider participant base and physically always better prepared athletes and, on the other hand, it is also the outcome of technological progress achieved in the domain of material-intensive sports. Thus, the Paralympic Games are competitions of top-class athletes and no longer merely a part of the rehabilitation sports, which was the focal point initially. This reflects a new social understanding of disabilities, where the physical deficiencies are not important, but the achieved performance by the individual; a wide range of new materials and technologies in the field of prosthetics have made Paralympics more attractive not only for the active athletes themselves, but also for the spectators and sponsors. At the Paralympics in Beijing in 2008, nearly 4,000 athletes from 146 nations have participated. This means that one hundred times as many as for the World Games for the disabled that were held for the first time at the Olympic Games in Rome in 1960.

Therefore, for people with disabilities, the opportunity of pursuing sports may represent a fundamentally important part of their lives - regardless of whether sports are intended for their rehabilitation, for their recreational activities or for achieving the best performance. On the whole, more and more people with disabilities are actively taking part in sports, as can be seen in the ever growing number of members of the *German Association of Sports for the Disabled Sports* (DBS). In order to ensure accessibility of sports facilities for all athletes and to allow more professionalization of sports for people with disabili-

ties in Germany, constructions must fulfil certain conditions that take into account a wide range of needs of all participants (athletes, escorts, coaches, spectators and so on).

Sports facilities must essentially be designed to make them *barrier-free*. This is in accordance with the specifications in the standard E DIN 18040 "Accessible construction"; it deals with the primary characteristic of a constructed habitat "by virtue of which largely all people are enabled to use it in a generally customary manner, without any particular difficulty and without the help of others". Accordingly, barrier-free sports facilities allow access and self-determined use to mostly all users, regardless of their disability. Therefore, creation of accessibility represents a basic planning objective that must be pursued right from the beginning of a design. In this regard, in the sense of a *universal design*, planning and design solutions must be developed for all user groups while avoiding segregating measures for any individual groups.

Where different types of Paralympic sports are being pursued, it can lead to specific constructional, organizational and sports functional requirements which must also be implemented at the sports venues.

## 2. Development and trends in sports for people with disabilities

Various types of sports for people with disabilities are characterized by their wide heterogeneity: the physical conditions and the nature and degree of severity of disabilities of the athletes can be very different from person to person. The *German Sports Association for the Disabled* (DBS), under the umbrella organization of the *German Olympic Sports Federation* (DSB), is the responsible professional association for all aspects of sports for people with disabilities. These include rehabilitation sports, recreational sports and competitive sports. The DBS is, simultaneously, the National Paralympic Committee for Germany and, in this capacity, a member of the *International Paralympic Committee* (IPC).

On the whole, more and more people with disabilities are actively taking part in sports, which is evident from the ever growing membership in the DBS. In 2008, more than 460,000 members were organized in the DBS. For 21 summer sports (Archery, Boccia, Electric Wheelchair Hockey, Fencing, Football, Goalball, Judo, Athletics, Cycling, Riding, Rowing, Rugby, Swimming, Shooting, Sailing, Dancing, Tennis, Table tennis, Goalball, Sitting Volleyball and Volleyball) and 4 winter sports (Hockey, Alpine Skiing, Nordic Skiing, i.e. Cross-country Skiing and Biathlon and Curling), the DBS organizes competitions at high-performance and international level; these are complemented by more traditional "German" sports like Fist Ball, Bowling, Sitting Ball, Bouncing Ball, Water polo and Volleyball, for which the DBS conducts state championships (DM). 17 national associations (federal states), 2 special associations and 7 organizations work together under the umbrella of the DBS (full members).

In addition to the above, other sports such as football for the blind is played at different levels in Germany.

### 2.1. Leisure and recreational sports

Leisure and recreational sports for people with disabilities is not fundamentally different from that of people without disabilities; sports represent for all people an enrichment of their lifestyle. The basis for recreational sports is to impart knowledge about and skills in the respective sports – they seek to encourage one's own initiative and the creativity of the people concerned to independently take part in their leisure activities. In addition to regular medical care being the main objective, sports for the disabled should mean that other aspects like strengthening and preservation of the person's remaining capacity and relief for the family members in their responsibilities of care must be of primary importance. An athlete with impairment is often introduced to popular sports through the organization in which he/she has participated in its time-limited rehabilitation sports programmes. In recreational sports, the focus is on the enjoyment of movement, games and sports in the context of social components which a club life provides. Opportunities in sports and disciplines in the recreational sports must be tailored to the person's disorder. In this regard, a comparison of performance is quite desirable. It is done in the form of recreational sports tournaments, games and sports events. The development and promotion within the framework of recreational sports refers mainly to leisure sports like winter sports (cross-country skiing, ski touring), water sports (swimming, canoeing, rowing and sailing), movement games and hiking.

## 2.2. Rehabilitation sports and functional training

Rehabilitation sports have, by virtue of the appeal of sports and athletic-oriented games, a holistic effect on people who are disabled and on those threatened by a disability. After an illness or after an accident, rehabilitation sports open up often the door to sports. The aim is to enhance endurance and strength, to improve coordination and flexibility, to strengthen self-awareness and to encourage self-help. In this, the group plays a catalytic role, because sharing with others, who have similar limitations, is especially important, and it positively supports the process and achievement of the goal of rehabilitation and its assurance. Besides gymnastics, athletics, swimming and active games in a group are recognized as rehabilitation sports.

## 2.3. High-performance and competitive sports

Competitive sports for people with disabilities are an integral part of sports for the disabled since the 1960s. The Paralympic Games in their current form have not been long established. In 1948 Sir Ludwig Guttman organized near London, where the Olympic Games were held then, the first international competitive sports for people with disabilities. In the following years at various venues sports competitions were held for people with disabilities, which received the title *Paralympics* in 1984. And in 2001 the *International Olympic Committee* (IOC) and the *International Paralympic Committee* (IPC) signed the agreement that the Paralympics must be conducted at the same venue ten days after the conclusion of the Olympic Games at the same venue.

In its programme structure, DBS mentions about 5,000 athletes participating in competitive sports. About 500 athletes fall into the category of high-performance sports and about 200 athletes were included in one of the cadres of the association.

## *International Sport Associations of Sports for the Disabled*

The International Paralympic Committee (IPC) is the umbrella organization for various cross-ranging international sports organizations (International Organizations of Sports for the Disabled, IOSDs) such as:

- CP – ISRA: Cerebral Palsy International Sports & Recreation Association
- IBSA: International Blind Sports Federation
- INAS – FID: International Sports Federation for Persons with an Intellectual Disability
- IWAS: International Wheelchair and Amputee Sports Federation
- FISA: Federation Internationale des Societes d’Aviron
- IFDS: International Federation for Disabled Sailing
- WOVD: World organization for Volleyball for Disabled
- IWBF: International Wheelchair Basketball Federation
- WCF: World Curling Federation
- ITF: International Tennis Federation
- IWRF: International Wheelchair Rugby Federation
- UCI: Union Cycliste Internationale
- FEI: Fédération Equestre Internationale

## *Impairments and classification of athletes with disabilities*

In order that athletes with their different disorders can compete at all against each other, they are grouped into various classes of disabilities. For this purpose, separate classification systems were created for every

type of sports, corresponding to either the rules of the IPC or the respective world federation. This means that the performance of the competitors among themselves can be compared. Only in this way fair and exciting competitions are ensured. In most sports, this is done on the basis of a medical examination, while in some sports there is additionally a functional classification system. The classification is done across various sports into five major groups (upper classes):

- Amputation and limb malformations: athletes with at least one major joint missing, often wearers of prostheses, sometimes also wheelchair athletes.
- Cerebral Palsy (CP): athletes who due to damage in the central nervous system (CNS) are limited in their movement skills (one or more control centres in the brain), sometimes also wheelchair athletes (seated classes).
- Visual impairment: athletes who are blind or visually impaired at varying degrees, with maximum residual vision of 10%. The divisions are made based on the better eye with the best practical correction.
- Paralysis: paraplegia, spina bifida and poliomyelitis are the most common causes, wheelchair athletes.
- Les autres: all other athletes with a physical disability.

At the XIV Paralympic Games in London 2012, athletes with intellectual disabilities will also be admitted again.

### ***Paralympic sports***

At Paralympics, currently 20 summer sports and 5 winter sports are held, namely:

- Archery, Boccia, Wheelchair Fencing, Soccer with 5 players, Football with 7 players, Weight-lifting, Goalball, Judo, Athletics, Cycling (Track & Road Racing), Riding, Rowing,

Wheelchair Rugby, Wheelchair Basketball, Swimming, Shooting, Sailing, Wheelchair Tennis, Table Tennis, Sitting Volleyball

- Ice Hockey, Alpine Skiing, Nordic Skiing, Biathlon and Curling

### **2.4. School sports**

Children and youth with a disability attend different types of schools that include special schools, integrated schools and schools with cooperation classes. As part of its educational mission, physical education makes a significant contribution to individual and social development of pupils. Here, the developmentally restricted and/or lack of movement patterns and physical impairments are taken into consideration. Physical education focuses on improving the abilities of perception, associated with cognitive performance, and on training coordinative and conditional abilities. Corrective efforts in respect of movement disorders should aim to develop individual activity-oriented abilities and consciously groom a social behaviour in order to harmonize it with the personal development of the pupils. As they gain the basic experience of movements like walking, climbing, running, crawling, climbing or sliding, conditions are created for them to transfer the experience into actions in their day-to-day life. At the same time, these experiences of movement are the starting point for sportive actions.

### 3. Basic principles of construction of accessible sports facilities

#### 3.1. Terminology

In order to describe the design requirements of a constructional environment, it has been the practice to apply concepts which are extremely diverging and often not clear in their definition; this is because the intended constructional environment is expected to enable every human being self-determination and participation in social life, without discriminating against the age or limitations of a person. In this guideline for planning, the following terms are used which are also explained subsequently. Furthermore, it should be noted that terms, such as athletes, always include both male and female persons.

In the terminology used for people with disabilities, the definitions are based on the *International Classification of Functioning, Disability and Health* (ICF) published by the WHO:

#### **Disability**

According to WHO (ICF), "disability is impairment of a body function or structure"; in this body functions are physiological functions of a body system, including psychological functions and body structures. The criteria for the classification according to WHO are: "(a) loss or lack, (b) reduction, (c) addition or excess or (d) deviation."

#### **Impairment**

Impairments are classified by the WHO into limitation of activity and participation. "Limitations of activity are problems that an individual can when performing an activity." And "impairments of participation are problems that an individual experiences when involved into a life situation." In this study, the term impairment is used in the context of practice of a sports activity functionally.

#### **Disorder**

For this term, there are many definitions, which differ according to the context in which they are used. According to the WHO, disorder is an "umbrella term for any restriction of the functioning of an individual." At the same time, the ICF refers to the importance of environmental factors: they "include all aspects of the physical, social and attitudinal world in which people live and unfold their existence."

With reference to the constructed environment, the following two terms are used in our observations here:

#### **Accessibility**

This term is used in the definition of the standard E DIN 18040. This is concerned with a characteristic of the constructed habitat, "by which largely its use is allowed to all people in the generally normal way, without any particular difficulty, and basically without the help of others". Therefore, wheelchair accessible sports facilities allow access and self-determined use to mostly all users regardless of their disability.

#### **Universal design**

This approach aims to develop a solution for all user groups so as to avoid segregating measures for individual groups. In this respect, the concept refers not only to the needs of people with disabilities, but includes all users. For example, the specific needs of the elderly, children, pregnant women and people of other nationalities or faiths are included. In this project, the term is used for constructional solutions with a high degree of usability available to everyone.

### 3.2. Legal basis

The basis for accessible construction in Germany is the Law on Equal Opportunities for the Disabled (Act concerning Equal Treatment of the Disabled - BGG) which aims to remove and prevent "discrimination against people with disabilities and to ensure equal participation of people with disabilities in the life of the society and to enable them a self-determined life. It takes into account their special needs." The Social Code (SGB), Volume IX - Rehabilitation and Participation of people with disabilities - defines the benefits that people with disabilities or those threatened by a disability deserve. It defines the term "disability" as follows: "People are disabled if their physical functioning, mental capacity or mental health is very likely to vary for more than six months from the condition that is otherwise typical for the age and, therefore, their participation in the life of the society is adversely affected".

Accessibility is also enshrined in the building laws of the states. It is stipulated in §50 of the German Model Building Regulation of November 2002 where numerous sports and recreational areas are explicitly mentioned. Currently the DIN standards 18024 and 18025 form the legal basis in this context. As early as 2006, with the draft version of DIN 18030 as a planned replacement for the standards 18024 and 18025, an attempt was made to adapt the legal framework to the current state of knowledge. Following the failure of DIN 18030, the draft of E DIN 18040, Parts 1 and 2, was presented in February 2009. This draft, which is significantly more comprehensive in its demands and statements as against the existing norms, served as an orientation for this project work, where the validity of the standards 18024 and 18025 is expressly pointed out.

The standard DIN 18024, Part 2 dwells in section 12 concretely on the requirements of sports, swimming, operational and leisure facilities; and in section 13, on places of public assembly, sports and restaurants.

Section 10 of this standard also insists on a folding chair and a changing table for washrooms in sports facilities. The draft of E DIN 18040 also includes specific requirements for sanitary and changing areas in sports facilities as well as for swimming and therapy pools.

In addition to the aforementioned standards, the following chapters provide a summary of the existing standards which are relevant to barrier-free planning and building in German-speaking countries; however, it does not claim to be complete.

For planning and construction of sports fields, DIN 18035, Parts 1 to 7 and for that of sports halls DIN 18032 Part 1 to 6 are relevant. Directives for the construction of baths are prepared and published by the Coordination Committee for Baths.

Laws, standards and other recommendations are subject to constant development; therefore, if they are to be applied, it is absolutely necessary to verify their current status.



Table 1: Overview of existing standards relevant to constructions

<b>Barrier-free construction in general</b>	
<b>DIN 18024-1</b> :1998-01	Barrier-free construction (roads, squares, paths, public thoroughfares, greeneries and play grounds)
<b>DIN 18024-2</b> :1996-11	Barrier-free construction (buildings and workplaces accessible to public)
<b>DIN 18025-1</b> :1992-12	Barrier-free living quarters (residences for wheelchair users)
<b>DIN 18025-2</b> :1992-12	Barrier-free living quarters
<b>E DIN 18040-1</b> :2009-02 (draft)	Barrier-free construction – Basics of planning – Part 1: Public accessible buildings
<b>E DIN 18040-2</b> :2009-02 (draft)	Barrier-free construction – Basics of planning – Part 2: Residences
<b>DIN EN 81-70</b> :2005-09	Safety rules for construction and integration of lifts – special applications for lifts meant for people and for goods – Part 70: Accessibility of lifts for people including for people with disabilities
<b>DIN 15325</b> :1990-02	Lifts; operating and signal elements and accessories
<b>Requirements of wheelchair users</b>	
<b>DIN EN 12184</b> :2009-03	Electric wheelchairs: Including recommendations for dimensions and spaces for movement
<b>DIN EN 12183</b> :2009-03	Muscle power driven wheelchairs
<b>Requirements of blind and visually disabled people</b>	
<b>DIN 1450</b> :1993-07	Labelling and legibility
<b>DIN 4844-1</b> :2005-05	Graphic symbols — safety colours and safety signs — Part 1: Basics of designing for safety signs for use in workplaces and in public areas
<b>DIN CEN/TS 15209</b> :2008-08	Tactile ground indicators made of concrete, clay and stone
<b>E DIN 32975</b> :2008-06	Designing visual information in public spaces for use without barriers
<b>DIN 32984</b> :2000-05	Ground indicators in public thoroughfares
<b>Requirements of visually and hearing impaired people</b>	
<b>DIN 18041</b> :2004-05	Audibility in small to medium-sized spaces
<b>DIN 32974</b> :2000-02	Acoustic signals in public areas – requirements
<b>ISO 23600</b> :2007-11	Accessories for people with visual impairments, including constrains on vision and hearing
<b>DIN VDE 0833-4</b> :2007-09	Hazard alert systems for fire, intrusion and assault — Part 4: Stipulations for systems for speech alarm in the event of fire
<b>Other standards and requirements</b>	
<b>DIN EN 13200</b> :2004-05	Spectator facilities
<b>DIN EN 12193</b> :2008-04	Light and illumination – Lighting system in sports facilities
<b>DIN 4172</b> :1955-07	Dimensional coordination in high-rise construction
<b>DIN 18100</b> :1983-10	Doors; wall openings for doors; dimensions according to DIN 4172
<b>VstättV</b>	Regulations on Places of Assembly passed by states
GUV-I 8527	Information – Floor covering for wet barefoot areas
GUV-R 1/111	Rules for safety and protection of health – Safety rules for baths
BGR 181	Rules – Floors in work rooms and work areas with danger of skidding

## 4. General requirements for all sports facilities

The following explanations relate to the basic requirements for planning wheelchair accessible sports facilities; and based on them, sports and sports facility-specific requirements are discussed in the following chapters.

### 4.1. Infrastructure of the surroundings and exterior accessibility

A sports complex must be integrated with its surroundings effectively so that it can be accessed by all users independently. Barrier-free access by means of local public transport (LPT) and by motorized personal transport (MPT) needs to be considered not only for the immediate vicinity of the sports facility, but also connecting facility to higher level transport (e.g. long-distance trains, airports) at competition venues must be taken into account. A wide range of accessible infrastructure (including leisure activities) is a prerequisite for attractive competitive events which will draw spectators across neighbouring regions. For the implementation of competitions in Paralympic disciplines, also there must be a sufficient number of accessible accommodation facilities of different standards (hotels, guest houses, etc.) available which can be easily reached from the sports venue.

Furthermore, sufficiently accessible information must be available on the Internet in order, for example, to enable people to plan their travel to the sports venue in advance and possibly to prepare themselves according to the specific needs of an athlete with disabilities.

#### **Public local transport**

The very design of the stopping point and the route from there to the sports complex make it apparent whether barrier-free access to the complex is available. For the blind and visually impaired people, who cannot use cars, providing the facilities of using local

public transport is significantly important so that they can reach the sports facility without being dependent.

#### **Motorized personal transport and parking**

Many athletes use their own or chauffeur-driven cars or a minibus to reach the sports venue. The transportation of sports wheelchairs, for example, can only be managed in that way.

According to E DIN 18040-1, parking space for people with disabilities should be at least 3.50 m wide, 5.00 m long and 2.50 m high; and parking space for a minibus should be at least 3.50 m wide, 7.50 m long and 2.50 m high. Since various boarding and alighting options and equipment handling require a lot of space, planning more manoeuvring space beyond the required dimensions is also recommended. In this case, one can assume that a wheelchair user requires 1.50 m of manoeuvring space. The transition points between the parking lots and other areas must be designed barrier-free (lowered kerbs, etc.).

The number of parking spaces for people with disabilities is governed by the local building regulations, whereas provision of space for minibuses is not regulated. Depending on the nature and importance of the sports facility and the type of sports being conducted there, several parking spaces for cars and, especially at competitions, minibus parking spaces are required. Following the ordinance on Model Assembly Locations (MVStättV) 1% (at least 2) of the spectator seats must be kept aside for wheelchair users. For every second of these spectators, barrier-free parking space must be provided (at least one).

Against the background that particularly wheelchair sports are likely to attract a higher proportion of spectators with disabilities, adequately flexible parking space needs to be provided in regard to parking lots for visitors as well as for athletes. This can be arranged according to the requirements of the

event through organizational measures, like using different signboards. The following options can be considered:

For the location of parking spaces for people with disabilities, E DIN 18040-1 specifies the proximity to the accessible entrances – which in terms of barrier-free construction for all user groups should be the main entrances. Moreover, it will be considerate for athletes with severe disabilities if the alighting areas are covered. They often need more time when alighting from vehicles; therefore, weather protection is also important. According to E DIN 18040-1, a clear passage height of a canopy of at least 2.50 m should be planned.

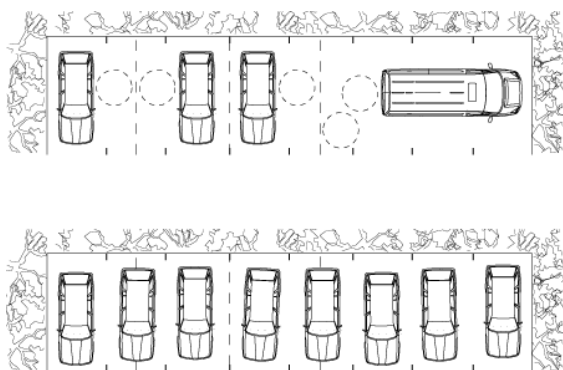


Fig. 1: Zoning of a large parking area

### **Path to the building**

The access from the car parking area or the stopping point of public transport should be made of flooring (large-sized tiles or asphalt) on which wheelchairs can roll on conveniently. The path must be wide enough to allow two wheelchair users meet each other (1.80 m and 2.30 m for sports wheelchairs). Well-spaced rest areas should be planned for the elderly and other users with physical disabilities by providing benches. At the same time, obstructive objects like bins should not be present in this pathway; benches must have such a design that they can be easily detected by any visually impaired person using a long cane.

Signage, guidance, etc. must be clearly identifiable and comprehensible for all users and should include information about the distance to the destination.

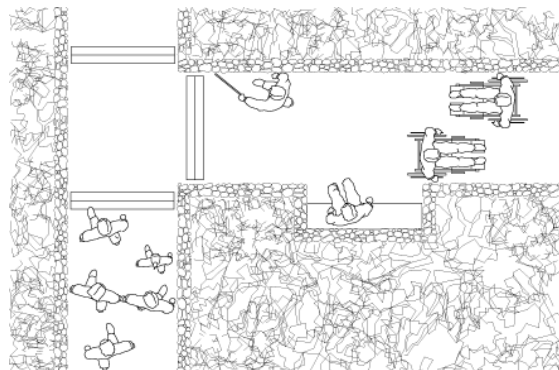


Fig. 2: Exemplary design of access routes

Besides sufficient lighting, visually impaired people need contrastive and tactile detectable guiding lines along the pathway to the building for orientation. In accordance with DIN 32 984, this is possible through ground indicators as well as "natural guiding lines" in the form of architectural design elements such as kerbstones or recesses along the pathway. What is very important here is that these guiding lines have no major interruptions but lead to the entrance on a direct and secure path. If a change of direction is necessary, it must be indicated at the point of change in the direction through visual and tactile detectable information. The design of the guiding systems should not differ significantly from that of commonly available systems in public spaces. The aim must be to take up these standards, to develop them further and to integrate them with the general guiding system which agrees with the *universal design*.

### **Building entrance**

In principle, a ground level access to the sports facilities should be implemented. In that case no major structural or technical measures are necessary and all users have equal access to enter the sports facility through the main entrance. Furthermore, the entrance area in the façade should be clearly contrasting and perceptible through appropriate signage and architectural accent. It would help everyone - even those with limitations on their cognition or their eyesight - locate the sports facility easily.

#### **4.2. Entrance area and interior accessibility**

The concept of interior accessibility of a sports facility influences decisively its usability and the surety of its functional procedures. An essential aspect of planning the sports facility is to draft a higher level concept of accessibility so that the internal processes can be optimized and barrier free access is maintained. In general, one must aim at ground level accessibility as well as organization of most important functional procedures at this level of access.

#### **Steps**

The minimum width of a flight of stairs, their ratio of ascent, the design of platforms, etc. can be found in DIN 18065 and E DIN 18040-1. What is essential is that stairs have straight runs and steps have risers. Construction of flanks on the sides of the steps into upturned structures must be considered in order to prevent crutches from slipping.

Stairs can also be a source of hazards. The elements of a staircase must be easily identifiable especially for people with low vision. This can be achieved by placing caution signs in front of the stairways to draw attention and by marking elements on the steps; models for these are described in E DIN 18040-1. Visually contrasting handrails should be constructed in accordance with this standard on both sides of the stairs. It is particularly important to build the handrail

matching with the geometry of the flight of stairs and to additionally indicate the beginning and end of the flight of stairs. Furthermore, it is useful to integrate the handrails into the orientation and guiding system of the entire sports complex: for example, to incorporate additional information on the underside of the handrail in Braille and in raised profile letters.

The quality of a staircase design should stand out against the common standards and in the choice of materials and in its constructional detail, because stairs are used not only as access ways, but also as devices for exercising or training.

#### **Lifts**

The requirements for the minimum size of lifts can be very different in sports facilities. At swimming pools, usually no transportation of large equipment is expected, whereas in sports halls possibly very bulky sports wheelchairs need to be transported (see Fig. 60, page. 76).

The minimum requirement for lifts, which are not meant for transportation of sports wheelchairs, is a cage with space for a power wheelchair and a companion; this corresponds to the lift type 2 according to DIN EN 81-70. Lifts should be located in a central area and clearly marked. According to E DIN 18040-1, a manoeuvring and waiting space of at least 150 x 150 cm must be available in front of the lift doors. However, a point to note is that larger groups of wheelchair users, as in the case of team sports or supervised groups in nursing facilities, need sufficient space in the traffic area where these groups can wait for each other, or enough space must be available for giving way to others. The type of sports facility and the architectural solution for the corresponding traffic area determine their dimensions. Generally, however, it is desirable to maintain maximum possible dimensions for lifts.

The lift can be designed as a so-called straight-through loader with two doors on

opposite sides to allow entry and exit without having to change one's direction. Doors with "entry from the corner" should be avoided. The other barrier-free layout of lifts does not deviate from the mandatory standards. It is important to maintain the same guiding and information system in lifts as well.

Lifts are designed according to DIN EN 81-70 and E DIN 18040-1 (see Fig. 60, page. 76).

### ***Corridors and manoeuvring space***

Depending on the size and the number of persons, in sports facilities the practice is to follow the requirements of structural fire protection for the width dimensions of necessary corridors.

However, all traffic areas must be designed wide enough bearing in mind the wheelchair users. In many sports facilities, a common location of meeting points appears to be inadequate. Basically, a recommended minimum width of 1.80 m must be maintained to allow meeting or overtaking of wheelchair users. This will ensure the usability of access roads even for larger groups of wheelchair users, for example, during competitions. In the case of sports venues, where sports wheelchairs are used, the dimensional requirements of corridors and manoeuvring space even exceed this (2.30 m).

Furthermore, corridors and other access areas must be kept free from obstacles which the blind and visually impaired people cannot perceive. This refers particularly to objects at head height (signs, coat hooks). Areas in a building, like the space below stairways with a clear ceiling height of less than 210 cm should be avoided or indicated accordingly, since it may constitute a source of hazard. This requirement is beyond what is prescribed in E DIN 18040-1, namely a minimum clear height of 200 cm; incidentally this takes the human dimensions and the physique of some athletes in certain sports into account.

According to E DIN 18040-1, glass walls or large glazed walls in traffic areas must be clearly recognizable, for example, by placing contrasting safety markings. All traffic areas must be well illuminated.

### ***Doors***

Physically disabled people must have a clear passage width of 90 cm and sufficient space in the door area. For sports facilities, it is recommendable to plan a passage width of 117 cm (126 cm unfinished) everywhere. The geometrical requirements for doors are summarized in a table in E DIN 18040-1. Note that the use of larger electric wheelchairs, scooters and sports wheelchairs for wheelchair rugby and wheelchair basketball is not considered here. Notwithstanding the dimensions given in E DIN 18040-1 door widths must be designed according to the requirements arising from the different Paralympic sports (as described in section 5.3) if games are to be held at the sports facility in such above-mentioned wheelchairs.

The point that door openers are an essential element of barrier-free sports facilities has been discussed in detail in the explanations about the entrance area. A door opener is not only important for the front door of the sports facility. Doors with a relatively large width, which is also necessary inside the building, can be difficult to operate. In order to ensure self-determined moving about within the sports complex, space-saving doors, sliding doors, doors equipped with a free swing door closer or operated by keys or even automatic doors should be used. The door handle itself must be clearly visible and contrasting. Especially in school gyms, the door locking systems must be sufficiently robust.

The passage widths for wheelchair users must be maintained in all areas of the sports facility. Thus, as many areas of the building can be used, especially during competitions.

Furthermore, the door panels and frames must be designed to enable people with visual disabilities, mental disorders, as well as those with cognitive limitations to locate them easily. According to E DIN 18040-1 this is achieved, for example, through:

- contrastive design, such as a bright wall / dark frame, bright wing / dark main closing edge and fittings, including contrastive design of flooring materials and any existing thresholds;
- avoiding reflections and glare.

The door signage must be integrated into the entire guiding system and also designed for tactile detection.

Glass doors and large glazed doors must facilitate reliable detection and be provided with safety markings (see also Fig. 61 and 62, page 77).

### 4.3. Orientation inside the building

#### **Requirements of wheelchair users**

The path guidance system in the sports facility should be the same for all users and the entire accessibility must be designed barrier-free; therefore, special measures need not be taken for wheelchair users.

#### **Requirements of blind and visually impaired people**

The functional areas of the sports complex, their arrangement and the internal routing system must be explored during the initial visit, if necessary, with the help of an accompanying person. If the local conditions are familiar, then, especially blind people would easily find their way independently. Nevertheless, even people with visual impairments must be able to use the sports venue independently also during their first and one-time visit; this can be accomplished if prior information (e.g. accessible websites) including information and guiding systems is provided.

Simple and easy-to-remember straight and rectangular routing in the building and a clear structure of the building can be the basis for uncomplicated orientation in a sports facility for blind and visually impaired people. Furthermore, a logical space syntax that corresponds with the functional procedures in the sports facility also helps better orientation.

In order to provide relevant information for people with visual impairments before they visit the sports facility, information should be provided about the sports facility and about its means of access, including public transport, on the accessible website maintained by the sports facility.

In accordance with the specifications of E DIN 18040-1 larger buildings should be equipped with as much complete information and guiding systems as possible; these include the corridors and other traffic areas and outdoor facilities. Information must be provided consistent with the *principle of two-senses* (simultaneous transmission of information for or from at least two senses according to E DIN 18040). An example of this is that humans use also the tactile (feeling, touching, e.g. with hands and feet) or aural (hearing) perception besides the visual perception (seeing).

**Visual information** can be signs and labels, as well as intense colour contrasting design of distinctive architectural elements. These can be perceived by all user groups if the lighting is adequate. Moreover, visual information must be visible and recognizable for people with low vision. According to E DIN 18040-1, the main influencing factors on vision / recognition are:

- Light density contrasts (bright / dark);
- Size of the visual object;
- Shape (e.g. letters);
- Spatial arrangement (position) of the visual object;
- Distance of observation.

E DIN 32975 forms, among other things, the foundation for designing visual information.

**Acoustic information** can serve as a substitute for information that is not perceptible to blind and severely visually impaired people. Thus, for example, information can be provided about whereabouts in the building and about the way to certain places through voice or audio signals by employing infrared systems. How in future such technical gadgets, which need to be installed in the building, can be relevant for the architecture remains a question considering the current technical development in personal systems.

**Tactile information** can be conveyed through various elements according to E DIN 18040-1. Tactile characters on signs can be presented in the form of raised Roman alphabet and Arabic numerals, as well as through Braille according to DIN 32976. Using tactile relief models and relief maps of a building and its exterior areas severely visually impaired and blind users can easily explore the spatial configuration the sports facility independently. A recommendation should be made in future about setting up models and maps (for example, always on the left in the main entrance, so that this itself can be located easily). Orientation aids, which are tactile detectable with feet, fingers or a long cane, must be very different from the surroundings, for example, in their shape, material, hardness and coarse surface.

All the information that can be conveyed through various senses needs to be combined to form a gapless system of orientation. "Ground indicators with a high tactile, acoustic and visual contrast with the adjacent floor covering" is a possibility according DIN 32984. These can be lined up to a guiding strip and thus indicate the course of a route. For example, integrated caution signs point to change of direction, bifurcations of

guiding strips or other special elements of information.

On the one hand, when designing the guiding strips, however, there is a need to go beyond the current standard of grooves and studded panels, and an orientation system must be developed corresponding to the overall architectural design of the building; on the other hand, these systems must conform to generally accepted definitions of significance so that the systems can be understood and used quickly and without explanation. This is especially important when indicating the source of hazards. This general concept must combine the requirements of children as well as those of people with intellectual disabilities and limitation of cognition in the sense of a *universal design*; this aspect will be taken up later in the ensuing sections. Moreover, the use of the premises with roller boards by amputee athletes or with trolleys with small rollers also needs our attention. Therefore, tiling with recesses is recommendable. In all, there are shortcomings in this area in view of the fact that the requirements are different and uniformity is lacking.

#### **Requirements of people with cognitive limitations**

The demographic trends suggest that a numerically rapidly growing group of users is expected which will be participating, for example, in rehabilitation sports at sports facilities. In old age, thought processes tend to slow down and this culminates into also actions slowing down. Therefore, suitably structured access corridors and orientation systems must be planned, which are equipped just with the essential but redundantly available information that is perceivable through different senses. In the case of incipient dementia, this is particularly helpful for users who are characterized by disorders of spatial orientation abilities.

#### **Requirements of people with different intellectual disorders**

The subject of building for people with intellectual disorders is hardly investigated. Generally, the requirements are similar to those of people with cognitive limitations and should contribute to intuitive orientation for all the users in the sense of a *universal design*. The focus must be on a clear and concise space hierarchy and guidance, supported by visual openness (visual relationships, predictable sequences of spaces, defining the areas of use, etc.).

#### **4.4. Changing rooms and sanitary facilities / basic element of Paralympics**

Every athlete should be able to reach changing rooms and sanitary facilities on a short path independently and without facing any perils, as much as possible at the same level, from the entrance of the sports facility as well as from the sports field or the swimming pool.

Whether separate changing rooms should be provided for people with disabilities depends also on the size and design of the sports facility. In order to be able to conduct competitive games, some or all changing areas should be designed barrier-free. In this regard, the privacy of every user in the changing rooms must be respected. In addition to sufficient manoeuvring space for the handicapped and accessible shower cabins according to E DIN 18040-2, the measures discussed already must be implemented to enable better orientation for people with visual disorders. Also all fixtures, especially the sanitary fittings and the area of the floor-level showers must be visually contrasting against their surroundings. Irritating patterns should be avoided. For people with cognitive limitations and mental disorders, the layout of changing rooms and sanitary facilities must follow a spatial syntax and the fixtures must be simple and convenient to operate.

If separate barrier-free changing rooms are designated in a sports facility for people with disabilities, they should be planned at the same time as a family changing room in the

sense of a *universal design*. Such mixed gender changing rooms are also important, because disabled athletes sometimes have a companion of the opposite sex and his/her help is particularly needed in the changing area.

Within the layout of changing rooms and sanitary facilities a convenient place must be planned for anyone who needs to carry out catheterization periodically (mostly as self-catheterization). In this procedure, the bladder is emptied using a sterile disposable catheter daily at regular intervals of four to six times. Also urine bags, holders and diapers are needed additionally. In certain cases of disorders, and often for women, a height-adjustable couch is necessary for using a catheter. This should be at the front end to the wall, so that one can lean against it. A washbasin in close proximity must be available for using catheters. People, who cannot or want to shift from a wheelchair, move directly towards the toilet. Using certain catheter systems, they can pass urine directly into the toilet, without having to shift. People with colostomy require similar conveniences in the sanitary facilities; here the close proximity of the toilet and washbasin is quite important. A washbasin in a public accessible anteroom of the toilet is not sufficient for a barrier-free toilet.

In every sports facility, one must examine if the user group of people with disabilities necessarily needs screened changing areas. Furthermore, in changing rooms and sanitary facilities always space must be provided for a person accompanying the disabled athlete, who will render assistance while changing or attending to calls of nature.

#### **Doors**

Installing sliding doors or space saving doors is recommended since they are easier to use and do not require too much space. Swing doors should not open into sanitary rooms,



because a wheelchair might block the entry. Furthermore, unlatching of the doors should be possible from outside the sanitary rooms. (See Fig. 61 and 62, page 77).

### **Flooring**

Flooring of the changing rooms and sanitary areas must be skid-proof as specified by the applicable regulations in GUV-I 8527. Since the risk of skidding is high for those using artificial limbs and walking aids, smaller units must be designed with the entire flooring at the same higher evaluation of group shower areas. Installation of a hand rail additionally will be helpful.

### **Toilet**

There are many different ways for a wheelchair user to transfer on to a toilet without assistance. A majority of the wheelchair users move diagonally across the front of the toilet, while some athletes use the toilet only to discharge the catheter. An “ideal solution” has not been found to deal with the situation satisfactorily. According to E DIN 18040-1 one should be able to approach a toilet by a wheel chair on both sides and a manoeuvring space of 150 x 150 cm must be available in front of the toilet. A single-sided access is also possible if another toilet is available close to it that can be accessed from the other side. Toilets must be designed to allow a WC or shower wheelchair to pass over the WC bowl, if necessary. As described earlier, always a washbasin must be installed in the space where the toilet is located.

### **Hand rails**

Supporting grabs fixed next to the WC assist wheelchair users when shifting to the toilet. Additional horizontal ( $h = 85$  cm) and vertical hand rails, which are located on the way to the shower and in the shower, can be helpful for amputees, who must move around in the showers without prosthesis, as well as for older people who may be insecure when walking or suffering from dizziness.

### **Washing area**

A washstand must be provided in every accessible toilet. To allow its use by wheelchair users, the washstand must be accessible to wheelchairs. The exact specifications of dimensions are shown in E DIN 18040-1. Single-hand soap dispensers, paper towel dispensers and waste bins and a hand dryer, all mounted at grip height for wheelchair users, are part of the equipment; however, they should not restrict the space for movements. In special cases, washbasins with integrated handles are possible. In this regard, the load-bearing capacity of the wall construction must be above average.

### **Couch**

A height adjustable couch is necessary for changing clothes in lying position and for using a catheter. It must be accessible at the footboard and on one side, so that the assisting person can move about freely. The second front end should be located towards the wall, so that a person can lean against it without constraints. The couch's dimensions should be at least 90 x 200 cm; one can sit on a couch of 90 cm width and lean against the wall comfortably.

### **Mirror**

A foldable or tilted mirror mounted above or near the washbasin will be convenient even for people using a wheelchair. Instead, a large mirror from the ground up to a height of 200 cm is useful for all users.

**Shower**

The shower area should have a manoeuvring space of 150 x 150 cm, and can have a level difference of maximum 1 cm to the adjacent bottom portion of the sanitary area (better without threshold). The shower area should be equipped with a folding seat, a hose pipe and a hand shower. If there are communal showers, a point to note is that maintenance of privacy is important (e.g. for breast cancer patients in swimming pools) for some user groups, and a privacy screen should be provided at least in one shower. Equally important is the construction of the gap in communal showers, which should not vary too much and could be built, for example, in one direction towards a wall. Sufficient storage space for shampoo, towel and glasses should be available not only for blind and visually impaired but also for all users.

**Emergency phone**

As long as personal alarm systems, which are currently still in development, are not yet established, an emergency phone must be provided near the WC bowl in accordance with E DIN 18040. It must have a contrastive design and be tactile detectable and discoverable and allow its use even while lying on the ground. Likely helpers in the sports facility should be able to forward an emergency call quickly.

**Changing table**

Families can use the changing rooms conveniently if a foldable changing table for babies and toddlers is integrated in this area.

**Lockers**

To meet the needs of different user groups, different locker designs should be implemented in a sports facility. If necessary, one should be able to keep prostheses in a locker. Considering the size of lower limb prosthesis, there should not be fixed compartments built within the lockers. Furthermore, lockers are necessary in different heights, which even people of small stature or children can use. For wheelchair users accessible lockers must be provided, but no benches should be placed in front of them. The indication of lockers should be contrasting and tactile.

**Clothes hooks**

To facilitate wheelchair users hang their clothes, hooks mounted at height of 120 - 160 cm are suitable. To avoid injury, the hooks should be covered or large, well-rounded, upward bent coat hooks can be mounted at different levels.



rectly from the field. This unit of space can also be used for doping checks.

Depending on the type and size of the sports facility, many of these rooms may need to be arranged. For example, for competition venues they are advantageous since handicapped athletes and possibly supporting caretakers of the opposite sex can share a changing room jointly without being assigned to "Ladies" or "Men".

Though not often, many athletes with disabilities are present at the same time, and the space proposed here can make a significant contribution to the attractiveness of the sports facility for all user groups: by equipping with a changing table and enough manoeuvring space, for example, for prams, and a couch in changing rooms for small children, it can be used as a family changing room. Requirements for accessible team locker rooms are discussed separately in the following sections depending on the type of sports facility. Other examples of floor plans see Fig. 63 to 66, pages 78 to 81.

#### **4.5. Catering and sales**

Especially at competitions, catering service as well as other sales outlets must be provided. Accessibility and convenient location of this area must be ensured for various users. The condition is that also for spectators with disabilities food and beverage joints must be accessible. Athletes must be able to reach catering facilities from the sports field and to return easily without having to cross the spectator area.

The furnishings in these areas should meet the needs of people with any kind of disability. Wheelchair accessible counters, legible sign boards or regulating mechanisms for background sound systems, among other things, must be planned. An important point to note is that different merchants use the facilities temporarily. The minimum standards of accessible dining facilities are defined by the German Association of Hotels

and Restaurants and they must be followed in sports facilities as well.

#### 4.6. Additional service facilities at competitions

##### **Rooms for doping checks**

Detailed requirements of equipment and basic stipulations for the arrangement of rooms for doping checks at competitive events governed by the rules of the IPC are published by the IPC in the Anti-Doping manual. Among other things, it defines the stipulations regarding the minimum size of the unit, the number of WCs and additional rooms to be available, all depending on the number of athletes to be tested per hour.

Athletes, who compete at the international and national levels, are subject at any time and any place to a doping test. Checks may be conducted in connection with a competition or outside the event, such as at the athlete's home or his/her training venue without notice. In this, both urine and blood samples may be taken.

Rooms, which are mentioned in the space management of the sports facilities under the name "doping checks", are used only for clerical work or as lounges for the medical staff. For the doping check itself a sanitary facility is needed, which must meet the requirements for accessible use of toilets at competitions for people with disabilities. In the room, besides a couch and a washbasin, also enough space for a supervisor and possibly an accompanying person must be available. In principle, the earlier mentioned unit of Paralympic basic module is suitable. This would be ideal, especially if more than one of these units were available in a sports facility and can be cordoned off separately for doping checks - otherwise external sanitary containers are set up, which are locked, and entry is allowed only for the athlete, the person accompanying and the inspectors. In the case of wheelchair sports, the contingency must be taken into account that the athlete has to visit this unit along with his sports wheelchair if necessary.

##### **Service areas for the organization of competitions**

At competition venues, additional rooms will be required for organizational activities (e.g. competition office, spokesman rooms, changing rooms for technical officials, classification, organization office, and doctor's office room). These rooms are already available either in the sports facility or sports grounds, or portable units are made available. The athletes are classified well before the commencement of the competition, just as the competition and organization office must be used before the actual competition. Since in sports for people with disabilities many of the officials may also have a disability, these rooms must be barrier-free and usable. Here, the requirements are not different from the general principles of barrier-free design and construction.

##### **4.7. Spectator areas**

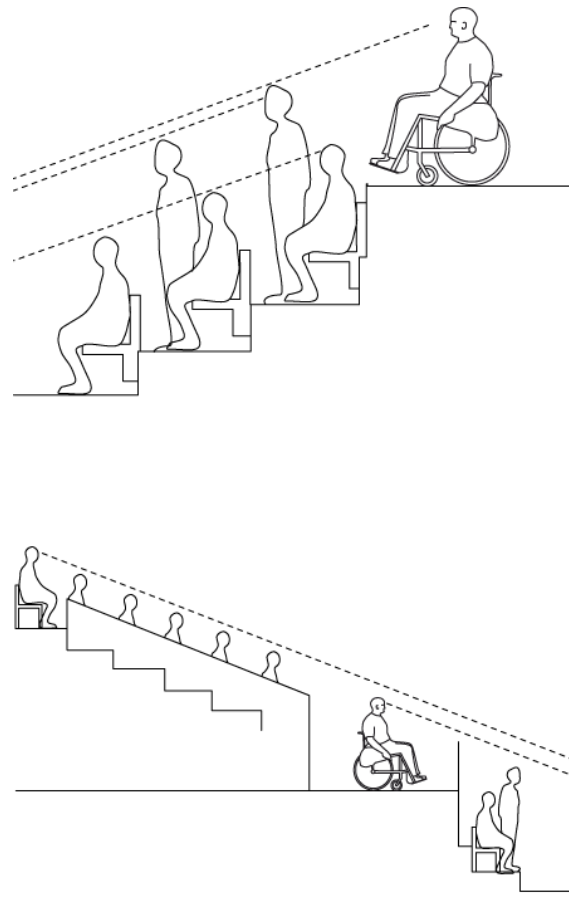
For some years now, the requirements of people with disabilities are becoming increasingly important when designing sports stadia. The essential element of a high quality of experience by this group of viewers lies primarily in the fact that they should be able to use the entire facility self-reliantly. Especially in larger sports venues, an information system that all can use it easily and conveniently is also important. Among other things, the requirements of blind (e.g. tactile maps) and visually impaired people (sufficient contrast and size) as well as those of wheelchair users (information at a lower level of approximately 120 cm) must be considered. Furthermore, in providing information about the sports complex, the 2-sensory principle must be applied (see E DIN 18040).

According to DIN 18032-1 the access routes for spectators should not intersect with those of athletes (except at the entrance). The access for wheelchair users, the access for all spectators *per se* according to the principles of a *universal design*, should be at ground level or over ramps and lifts. However, when planning the seating for wheelchair

users, another important aspect is how evacuation is carried out in case of fire.

The structural design of spectator facilities is illustrated in DIN EN 13200. Part 1 deals with the criteria for the spatial layout of spectator seating. In addition to these requirements, differentiated spaces for wheelchair users, also in different price ranges and in the desired fan block must be compulsorily built. Furthermore, according to DIN EN 13200, in the spaces for wheelchair users, seats must be arranged for their accompanying persons. It is important that maximum flexibility is available in seating, so that groups with different numbers of wheelchair users can sit together. This can be achieved, for example, by equipping some seats with folding seats in the areas designated for wheelchair users. These can be used either as a seat for the escort or as storage space for wheelchairs. Accessible toilets must be available near the seating area for wheelchair users.

The number of places for wheelchair users depends on the federal states' directive for the venue of assembly. According to the Model Ordinance on Venues of Public Assembly (MVStättV) at least 1% of the visitors seats (at least 2 units) must be provided for wheelchair users; they must include also visitors' seats for accompanying persons. Moreover, the above ordinance points out that the seats for wheelchair users and the directions to these must be clearly marked by visible signs. The allocation of 1% of visitors' seats as space for wheelchair users for stadia up to about 20,000 seats certainly sounds good, while in larger stadia probably a smaller percentage will be required. According to Football Stadia Improvement Fund and Football Licensing Authority, for comparison in UK, 100 wheelchair user seats are needed in a football stadium with 10,000 spectators, but only 210 wheelchair user seats in a stadium with 40,000 spectators.



*Fig. 4: Arrangement of wheelchair user seats to ensure unobstructed lines of sight. (Source: Football Stadia Improvement Fund und Football Licensing Authority 2003)*

A construction that takes the line of sight into account in spectator facilities is particularly important. A formula for its calculation is specified in DIN EN 13200-1. The line of sight of the wheelchair user, which may not be blocked by objects (parapets, railings) or standing persons (fans jumping up), is shown here in an example. Detailed information about construction within the line of sight, where particularly the requirements of wheelchair users are considered, is clearly illustrated in the publication *Accessible Stadia* Football Stadia Improvement Fund and the Football Licensing Authority in UK. This is taken from the following drawing.

For people with hearing impairments, inductive loop systems, over which announcements and possibly even game commentaries are transmitted directly to the hearing aid, may significantly improve the quality of experience at a sporting event. The core of an inductive loop system is an induction loop, which consists of a wire coil, and is placed in the floor, in the wall or in the ceiling. Within this range, the transmission takes place to the hearing aid of the hearing impaired and the person can move around freely, without the need for cables, headphones, speakers and so on. The inductive loop systems are calibrated in accordance with DIN EN 60118-4. Optionally, the projection of a mouth image (the lower face area and lips) of a game commentator can be considered.

For blind and visually impaired people, commentary of events on the field can definitely increase the quality of experience. An appropriate transmission technology as well as headphone systems must be provided. Moreover, conveniently visible, high-contrast and sufficiently large displays are helpful for this group.

Furthermore, some of the blind and severely visually impaired people own a guide dog, for which space must be available within the spectator seating area, and free space in the outdoor area (such as a dog park) including water bowls.

#### **4.8. Acoustic requirements**

General announcements through a public address system intended for all users of the sports facility should be audible even to people with limited hearing, and verbal communication should be possible easily. According to E DIN 18040-1 this is facilitated by avoiding the following disturbances:

- noise within rooms;
- sources of noise acting from the outside to the room, and

- poor room acoustics with long reverberation periods.

The acoustic quality of a sports facility can significantly contribute to the process of a stress-free training or competition and is a basic necessity for people with low vision. Especially in parallel (multiple) sports operations the requirements of the room acoustics must be taken into account.

DIN 18041 - *Audibility in small to medium-sized rooms* - essentially describes the requirements for sound absorption and reverberation time of various sports venues. As part of the *universal design* and depending on the frequency of the language, the desirable range of the reverberation time should be planned everywhere to ensure optimal voice communication for people with speech and language processing disorders or difficulties in concentration or attention and with limited hearing abilities. This is all the more important if these people are not using their native language. By adhering to these requirements, ideal acoustic conditions are created even for blind and visually impaired persons.

For persons with hearing impairment, special measures, such as various signal transmission systems must be planned.

DIN 32974 is concerned with the requirements of acoustic signals in public areas.

#### **4.9. Evacuation, protection against fire and disasters**

The investigation of measures concerning protection against fire and disaster including evacuation was not the subject of this project, but they are considered to some extent.

The alarm system is particularly important and it should be implemented according to the 2-sensory principle. This means that both acoustic (e.g. announcement or siren) and visual alarm systems must be implemented (e.g. blinking light). According to E

DIN 18040-1 "in the concepts for fire protection the needs of people with mobility and sensory impairments must be taken into account, for example:

- by providing safe areas for temporary shelter, but not for self-rescue of capable people;
- by ensuring additional visual perception of audible alarm and warning signals, especially in areas where hearing impaired people can stay alone, such as toilet facilities. It is recommended to provide additional acoustic systems pointing in the direction of escape with prescribed optical signage on escape routes, see DIN 4844-1;
- by operational measures."

In larger sports venues with a high seating capacity, it is often not possible to ensure a direct, ground level escape route from all parking places for wheelchair users. At the same time, it is not a solution in terms of *universal design* if seats for wheelchair users are reduced to only one level for reasons of organization of escape routes. According to E DIN 18040-1 it appears to be sensible to establish well-defined, secure locations as a temporary shelter for wheelchair users. From there, evacuation can be carried out by the fire department, which must have the appropriate contingency plans for sports complexes. Planning the evacuation of wheelchair users is based on the building regulations and the object-specifically drafted fire protection report.

## 5. Sports halls and multi-purpose sports halls (specific requirements)

### 5.1. Practised games - Sitting Volleyball, Wheelchair Basketball, Wheelchair Rugby, Goalball

Ball games are regarded as an important part of sports for the disabled. In many sports, they are played for warming up; they are integrated with the therapy process and contribute to acquisition of new learning processes.

They make a major contribution in integrating people into sports activities. The interaction between people with and without disabilities is possible, and in the case of some sports even in competitive sports.

The development of ball games dates back to the World War II. It was the war veterans who have introduced the ball games as rehabilitation measures. From the historical point of view, a close relationship can be observed between the understanding of physiotherapy and sports as a complementary measure of medical rehabilitation and the rapid increase in life expectancy of paraplegics.

#### **Sitting volleyball**



Fig. 5: Playing sitting volleyball



Sitting volleyball was derived from the traditional volleyball game for players who are unable to stand upright. Since 1992, sitting and standing volleyball games are represented by a separate international organization: the World Organization Volleyball for Disabled (WOVD).

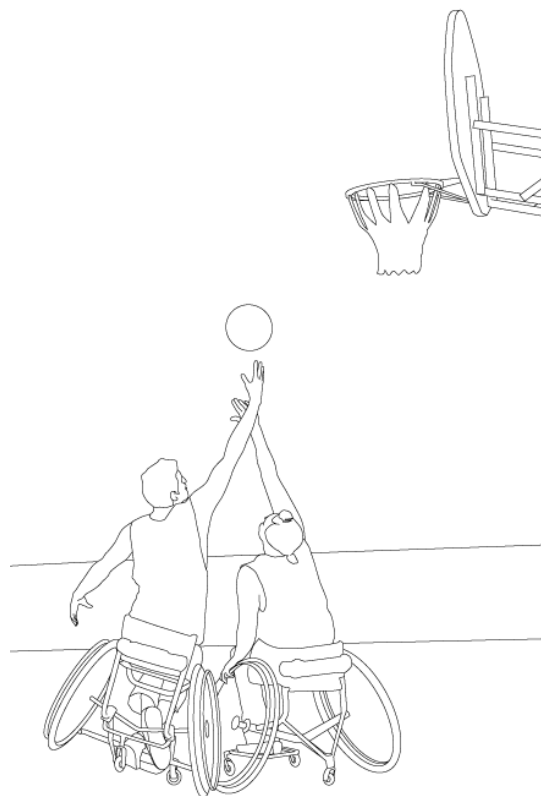
Each team consists of maximum twelve players. Six players in each team play with a volleyball on a playing field measuring 10 x 6 m. The net height is 115 cm for men's teams and mixed teams, and 105 cm for women's teams. The players move on the floor by sliding. On contact with the ball, the body must touch the floor. Points and (depending on tournament type) two or three winning sets are counted. From the viewpoint of the rules of the game, sitting volleyball is still strongly modelled according to the gaming systems of the classic volleyball (FIVB Rules of the Game, Official Volleyball Rules, 2009 - 2012). One difference, for example, is that in sitting volleyball the task block is allowed. Changes in rules are relatively quickly applied to the rules of sitting volleyball in modified form, if necessary.

There is no classification in sitting volleyball. Players with an amputation (usually in the limb area), paralytic polio, Les autres athletes and so-called "minimum handicap" players who cannot play standing (for example, due to an unstable knee joint) play together. Although there are international competitions since 1993 for women also, it is played in mixed teams at the national level.

### **Wheelchair basketball**

Besides table tennis, wheelchair basketball is one of the most popular sports games for wheelchair users. In many rehabilitation facilities wheelchair basketball is offered as a recreational sport, since it is a good way to familiarize oneself with the wheelchair and to deal with it better because the game can be a motivating factor. In Germany it is the only game in sports for the disabled in which the league system is practised.

Wheelchair basketball was played in 1946 by former basketball players in the United States for the first time.



*Fig. 6: Wheelchair basketball game in progress*

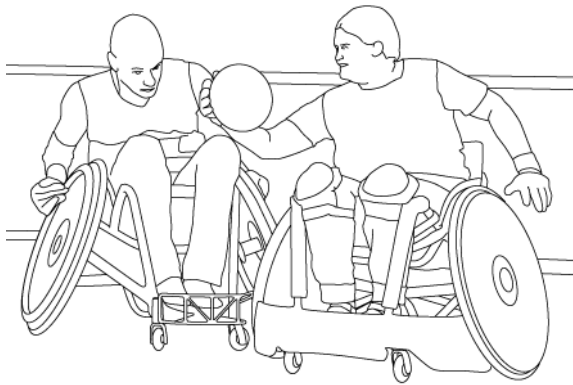
The rules of wheelchair basketball emulate the rules of the classic basketball. The main differences arise from the specific requirements of the wheelchair usage. A team consists of twelve players: five field players, who have a different severity of a physical disability, and up to seven standbys. The game is played for 4 x 10 min. The dimensions of the playing field, the zones and the time rules are mostly similar to those of the classic basketball.

In its origin, wheelchair basketball was sports for paraplegics. Since the introduction of the functional classification system in the 80s also athletes with "other" impairments (amputees, etc.) can also play. The classification establishes a balance between athletes with different impairments. The division is made in 0.5 increments of up to 4.5 points.

Since the 90s, also the so-called "minimal handicapped" and "non-disabled" can also play. Also in wheelchair basketball, it is played in mixed teams not only for training purposes, though competitions for women do exist.

The rules of wheelchair basketball of IWBF were developed based on years of experience in the RBB area. They are based on the rules of the International Basketball - Federation (FIBA).

### ***Wheelchair Rugby***



*Fig. 7: Wheelchair Rugby game in progress*

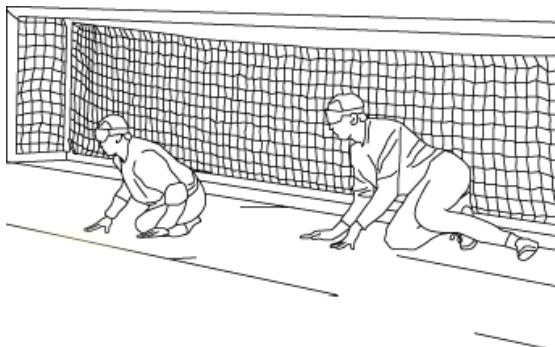
In order to give a chance to even athletes, who suffer from severe motor impairment in all four limbs due to a spinal cord injury, to participate in sports murderball was evolved towards the end of 1970s in Canada as a team game for people with disabilities in at least three limbs. Wheelchair rugby has its origins in wheelchair basketball – the basic techniques of basketball were modified and techniques were developed and enshrined in the rules that suit the limited mobility of quadriplegics better. Participation of women in wheelchair rugby is very insignificant; and all-female teams or competitions do not exist. However, so as to promote participation of women, teams that include women players are favoured in the total score.

Wheelchair rugby is played on a basketball court without a basket. On both front ends there are goal lines of 8 m width. The effective play time (without breaks) is 4 x 8 minutes, at the end of the first and the third session there is a one-minute interval; and at the end of the second period, a five-minute break. If the score is equal, there is one or, if necessary, several extensions of each 3 minutes. The team consists of four field players and up to eight stand-by players. The ball can be rolled, hit or thrown, and the opponent can be actively prevented by pushing or jamming his moves. But physical contact is strictly prohibited.

The International Tournament Rules of 2006 form the basis for the tournament, which is published by the Technical Commission of the IWRF of the International Wheelchair Rugby Federation, founded in 1993.

Wheelchair rugby was developed in its origin for athletes with paralysis of the cervical spinal cord. As this sport was further developed, the player base has been expanded, for example, to enable also players suffering from multiple sclerosis, polio paralysis, arm amputations, muscular dystrophy, early childhood brain damage or cerebral palsy. The common criteria are the failure symptoms, or complete loss of function of at least three limbs. In wheelchair rugby the classification is according to a points system. Athletes are classified into one of the classes from 0.5 to 3.5 points. Awarding a score is determined not only from the profiles defined according IWRF, but also based on the abilities of a player resulting from the match observation.

## Goalball



*Fig. 8: Game in progress at the goal*

Goalball is one of the few games in sports for the disabled for which there is no equivalent in the sports for people without disabilities.

In Goalball two teams enter with three players competing against each other; three other players wait on the team bench as changing players during the competition. Visually impaired and blind players wear eye protection (non-transparent goggles), so that all can play on equal terms. The goal is as long as the base line (9.00 m), and also serves as the tactile orientation for the players. For orientation, there are also the base and side lines, and the individual lines that highlight each field zones and the additional guidelines. During the play a bell ball is rolled back and forth, until it either ends up in the goal or outside, or remains on the field as a "dead ball". Playing time is 2 x 10 min, but from 2011 it is increased to 2 x 12 min. During the actual action of the game, silence is maintained in the hall as soon as the referee starts the game verbally (also after breaks) in order not to disturb the players in their concentration. After a successful goal and at the end of the half-time people are allowed to applaud.

Goalball does not have its own international sports federation; the jurisdiction is exclusively with the IBSA (International Blind Sports Federation), which also formulates the rules. There is no differentiated classification in Goalball as in the case of other sports. Players must be classified into one of the sub-classes B1, B2 and B3 according classification system of the IBSA. The game is played internationally in women's and men's teams, while in national games also mixed teams are possible.

## 5.2. Sports facilities and game specific standards and recommendations

Following basic standards must be applied:

- DIN 18032-1: Sports Halls, Halls and Spaces for Sports and Multipurpose Utilization - Part 1: Principles of Planning
- DIN V 18032-2: Sports Halls, Halls for Gymnastics, Games and Multipurpose Utilization - Part 2: Sports Floors – Requirements, Inspections
- BISP Seminar Report J1/02 Planning and Construction of Halls and Spaces for Sports and Multipurpose Utilization
- IAKS Journal No. 26: Sports Floors, IAKS Recommendations
- IAKS Journal No. 29: Principles of Planning for Sports Halls
- Directive for the Construction of Sports Facilities: Accessible Sports Facilities, ÖISS 2005
- GUV-V S 1, Regulations for Prevention of Accidents - Schools

### 5.3. Functional procedures in the sports hall

The functional procedures during training and competition are performed according to different scenarios that depend not only on the type of sports, but also on various concepts of training and mobility. They directly depend on the available space and are influenced by it. One must understand the sophisticated and optimized organization of these sequences and of the appropriate area and space requirements as well as the structural aspects as a basis for planning these sports venues.

#### **Changing the prostheses**

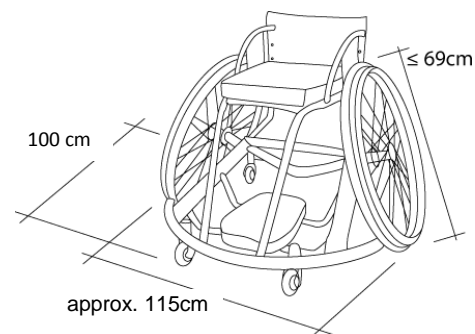
Prostheses are not allowed into the game. Therefore, for the athletes it is particularly important, when and where they can keep their accessories safely. If the prostheses are kept in the changing room the path between the changing room and the sports field needs to be planned carefully. If possible, it should be a short path. Since some athletes move on roller boards in this area, generally thresholds and steps must be avoided (below 2 cm). The fixtures in the changing rooms should allow safe storage and handling of the prosthesis.

If the prostheses are kept on the sidelines of the sports field, there must be seating and storage facilities.

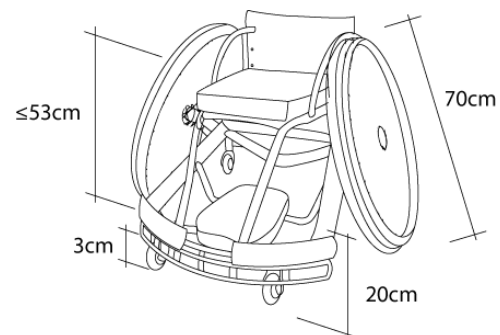
#### **Use of sports wheelchairs**

Unlike the conventional sports wheelchairs with a width of about 85 cm to 100 cm, in wheelchair basketball and wheelchair rugby special sports wheelchairs are used. The wheelchair is made for each athlete specially and customized to the body. Although the international regulations define certain measurements, such as the seat height or wheel diameter, every wheelchair is different in its dimensions. Unlike the standard wheelchairs, the negative wheel camber gives the rugby and basketball wheelchairs the needed stability while remaining highly manoeuvrable. Since the special geometry

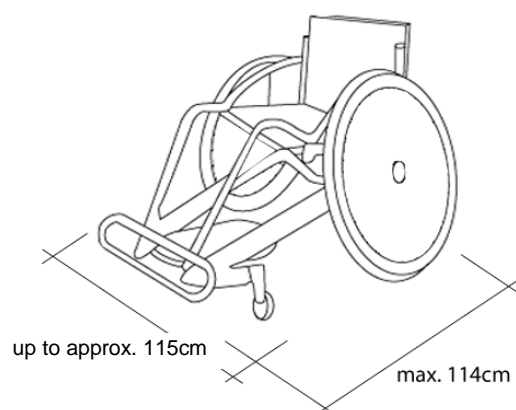
of the sports wheelchair exceeds the conventional dimensions, attachments and space larger than normal standards will be required.



*Fig. 9: Basketball wheelchair*



*Fig. 10: Offensive type Rugby wheelchair*



*Fig. 11: Defensive type Rugby wheelchair*

### Wheelchair transport

The manoeuvring space up to the place for changing into the sports wheelchair must be sufficiently large to enable an athlete sitting in a street wheelchair push forward his wheelchair that he brought along or fetched from the storeroom. Here, especially the situation in front of the doors and meeting areas must be considered carefully.

A point to note here is that some athletes may face problems while driving their own wheelchair and simultaneously pushing the sports chair because of their limited hand function. The required space is about 200 x 115 cm.

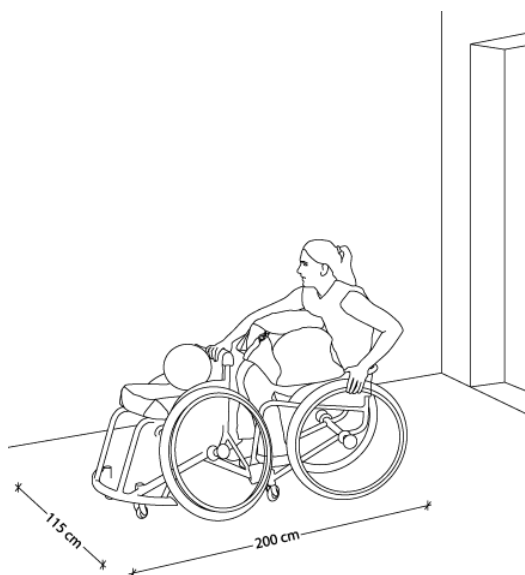


Fig. 12: Required space for wheelchair transport

### Turning sports wheelchairs

The manoeuvring space for turning a standard wheelchair is defined in E DIN 18040-1 as 150 cm. This measure is intended as a basis for barrier-free planning and building and should be respected in any case. When turning the sports wheelchairs following aspects should be taken into consideration:

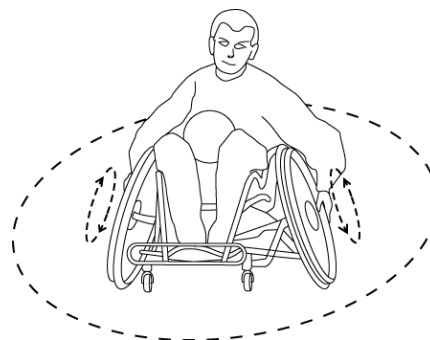


Fig. 13: Turning diameter in counter rotation,  $R=1.50m$

The turning diameter of a basketball and rugby wheelchair is determined by the anatomy and the physical capabilities of its user, and by the position of the centre of gravity and the motion of the front wheels. In wheelchair basketball, it can be assumed that the hand functions of the athletes are not restricted and, therefore, the wheelchair wheels can also move in the opposite direction. In wheelchair rugby, however, it cannot be assumed that each player can move his wheelchair without restrictions.

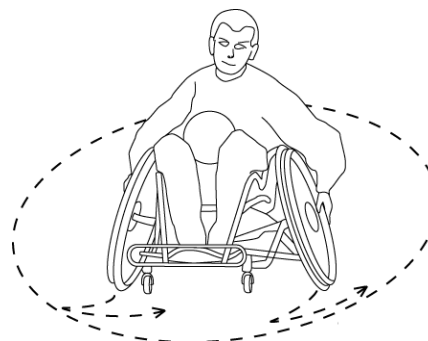


Fig. 14: Turning diameter while manoeuvring,  $R=1.50 m$

The size of a turning area of 1.50 m is sufficient for most athletes. It can also be assumed that when planning a sports facility space would become available, due to other requirements like meeting areas, on which the turning on one's own axis (about 2.20 meters) is possible.

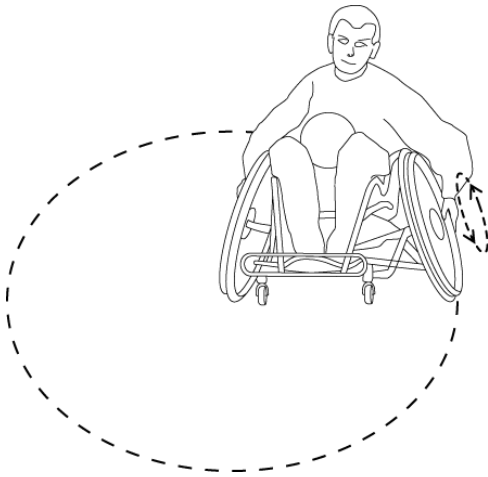


Fig. 15: Turning diameter without counter rotation,  $R=2.20\text{ m}$

### **Changing the wheelchair**

The sports wheelchairs can be either brought every time or stored at the sports venue. The safety of the sports but also of the standard wheelchair should also be planned, since they are very expensive objects.

The place for changing into the sports wheelchair significantly influences some structural dimensions of the sports facility. Basically, it is important to go through all the different actions to find the right solution according to the specific situation of training or competition.

Near the playing field a conveniently accessible toilet must be available for each variant (for smaller systems it can also be the toilet in the foyer area), which athletes can reach with their sports wheelchair. At least one "Paralympic basic module" should be available. The clear door width here is about 125 cm (138.5 cm unfinished) - so that this sanitary unit can be used by athletes with a sports wheelchair as a place for changing the catheter, but also as a changing room and shower facility.

### *Changing the wheelchair on the sidelines of the playing field*

The pathways between the entrance area and the sports field, and those between the sports field and the storage must be wide enough to allow a sports wheelchair to be moved backward or forward easily. On the sidelines enough space is needed for changing the wheel chair and for keeping the standard wheelchair; in this regard, the safety and the undisturbed process of training or competition must be ensured. Accessibility to sanitary rooms in the team changing room with the sports wheelchair can be dispensed with. It is sufficient if these areas are accessible only by means of a standard wheelchair.

### *Changing the wheelchair in the changing room*

The pathways between the entrance area, the changing room and the storage must be wide enough to enable athletes move their sports chairs backward or forward conveniently; the pathways between the changing room and playing field must be sized accordingly for the sports wheelchair. The layout plan for the team changing rooms must be convenient if many athletes have to be moved or shifted simultaneously – in this regard, the space requirement must be taken into account. Accessibility to sanitary rooms in the team changing room with sports wheelchair can be dispensed with; athletes can use their standard wheelchairs.

### *Changing the wheelchair outside the sports facility*

All pathways between the entrance and the sports field should be accessible by a sports wheelchair. Accessibility to storage areas is of not important in this solution. However, accessibility to other sanitary facilities with the sports wheelchair needs to be examined in each case.

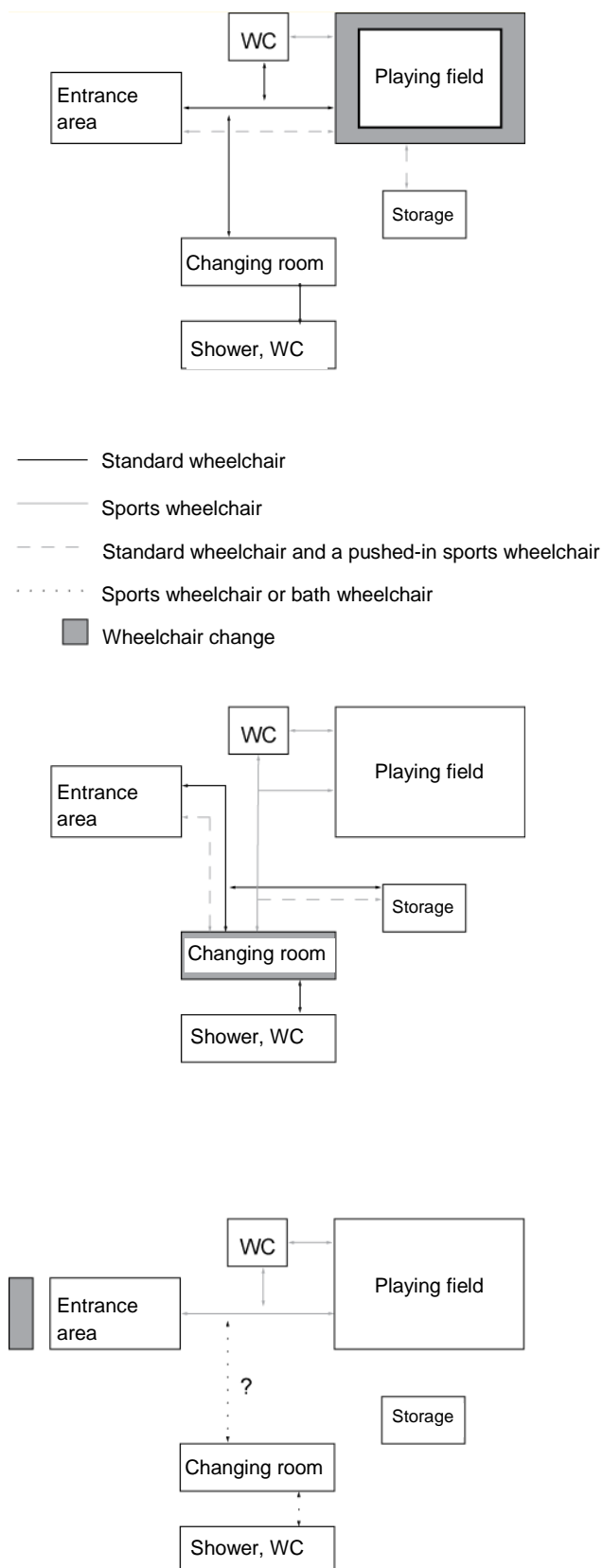


Fig. 16: Functional procedures – Sports hall

### Transfer

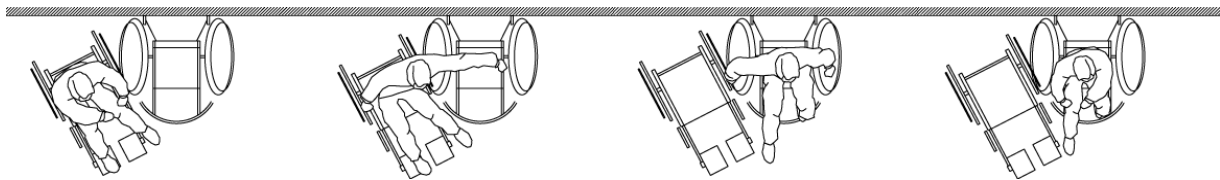
There are various possibilities for moving over from a standard wheelchair into a sports wheelchair. Depending on the functional abilities and the anatomical condition, such as the strength and flexibility of arms and torso, and according to the static load capacity of the limbs, each athlete develops a suitable technique to manage changing between the wheelchairs, but some need to be assisted by one or two persons.

In planning the manoeuvring space, one must not forget the fact that sports wheelchairs do not possess brakes and so they

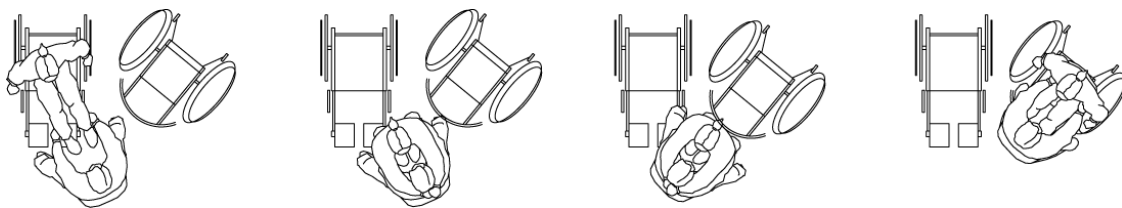
can slide away easily. A way to arrest a wheelchair or to fix it next to a wall or a furniture item (e.g. lockers) can be particularly helpful.

E DIN 18040-1 specifies a required space of 180 x 150 cm for changing the wheelchair; in front of this an additional space of 180 x 1.50 cm must be available for manoeuvring.

Spaces shown below are intended as a basis for the actual change of a wheelchair; the manoeuvring, which can extend, for example, into the team locker room must be planned additionally:

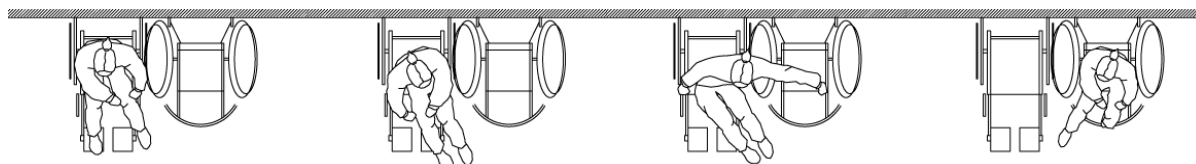


*Fig. 17: Wheelchair change at an angle of 90° or obliquely, without assistance, is suitable for athletes who possess well-conditioned upper arms. The sports wheelchair can be secured against a wall or pressed only by the force of the upper arms against the standard wheelchair. The athlete keeps one or both feet on the floor, leaning with one hand on the sports chair, and leaning with the other hand beside the upper body, pushes his upper body out of the chair and jumps onto the sports wheelchair - after which the propped hand slips in. Finally the legs are placed on the footrest. The space required is approximately 190 x 150 cm*

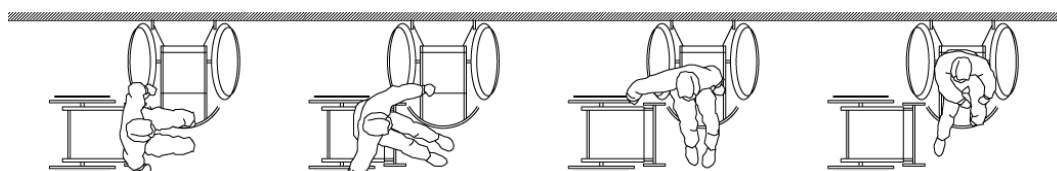


*Fig. 18: Wheelchair change at 90° or obliquely with a helper. If a wheelchair change is made at angle of 90° or obliquely with the support of a helper, space for these - standing or crouching - must be taken into account. Leaning against the wall can be ignored by holding the helper. The total space required is about 200 x 200 cm.*

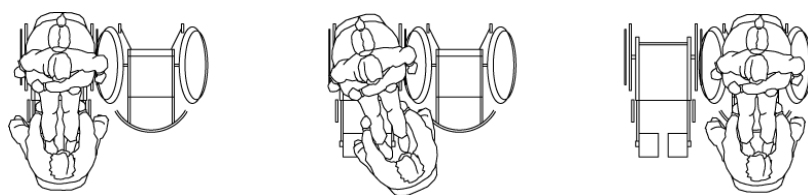




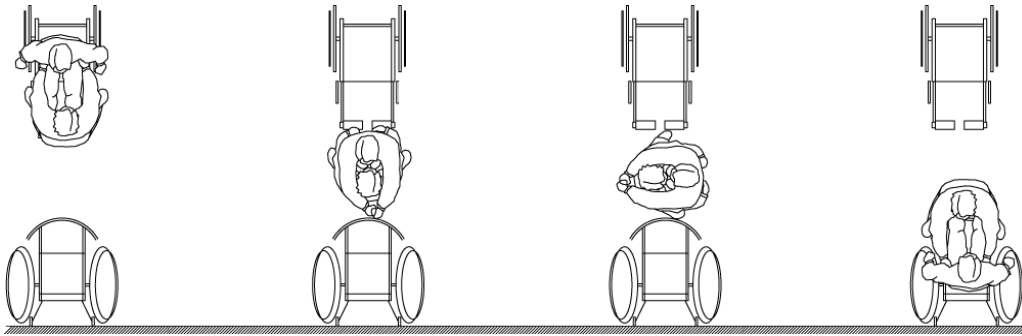
*Fig. 19: Wheelchair change with a sliding board, without help, can be carried out slowly, bit by bit, with or without help. This method is suitable for athletes who have limited conditioned upper arms and / or poor self-supporting ability. The wheelchairs are side by side or slightly oblique; the custom-made board, possibly with cut-outs for the wheels, is placed between the wheelchairs. The athlete keeps both feet on the floor, and leaning with one hand on the sliding board, with the other hand supports himself next to the upper body and pushes his body sliding on the sports chair - the hand supported on the board slips in. Once the athlete sits in the chair, the legs are placed on the footrest and the board is pulled out from under the buttocks. The space required is about 190 x 130 cm.*



*Fig. 20: Wheelchair change diagonally from the front is mainly carried out without help. This method is suitable for athletes who have well-conditioned upper arms and a short ability to stand. The sports wheelchair can be secured against a wall or held by the athlete only by the force of the upper arms. The athlete keeps both feet on the floor, and leaning with both hands on the sports chair, pushes his upper body out of the chair and turns (with short steps, or slight twisting of legs), the upper body towards the seat into the sports chair, slips back towards the back rest and keeps the feet on the footrest. The space required is about 190 x 200 cm.*



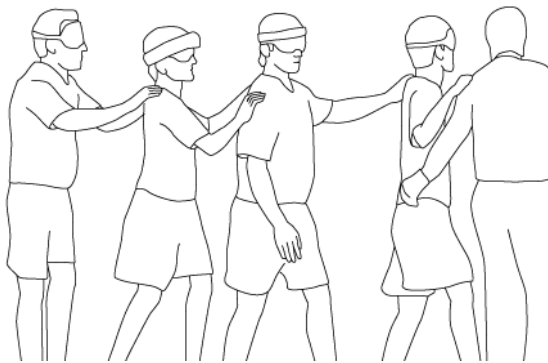
*Fig. 21: Wheelchair change helped by two people. For athletes with severely limited mobility assistance by two people is required. Sometimes even support by another device, such as a lifting equipment etc., is necessary. Here the space required is about 220 x 220 cm.*



*Fig. 22: Wheelchair change at an angle of 180 ° assisted by a helper is ideal for athletes who have a poor self-supporting ability, but short ability to stand. The athlete's feet are kept on the floor, and a helper supports the athlete under his arms, holds the arms and upper body while both stand up together. Using a turntable under the athlete or step by step both turn and the athlete is set slowly back into the chair. Finally, both feet are placed on the footrests. In this method, the sports wheelchair must be fixed, for example, against the wall or against permanently installed furniture. The space required is about 120 x 250 cm.*

### **Orientation**

A simple and clear routing system, not only in Goalball, but also within the entire sports facility is extremely important; it must be supported by guiding systems placed at vantage points.



*Fig. 23: Movement of a Goalball team at a competition in an unfamiliar sports facility*

### **Divergent functional procedures in the competition**

Depending on the size of the event, a large area may be required. Also the number of accessible changing rooms and sanitary units depends on the number of participating teams. In this regard, wheelchair rugby re-

quires more space. There are 12 players in each team with varying needs for assistance and space.

Even if some of the athletes find it too cumbersome and time-consuming to use the sanitary facilities and do not use them (own survey, wheelchair rugby), these should be available for each team nonetheless. On a temporary basis, barrier-free sanitary units can be built indoors or also outdoors if necessary.

Wheelchair change on the sidelines at a competition is usually not possible, the standard wheelchairs remain in a changing room or at a place assigned to the team. For events held on several days, the sports wheelchairs should be stored in these rooms. A viable solution to this is to divide a larger space (such as a training track or a smaller sports hall) into areas; these are available to each team and can also serve as a warm up area.

Although a Goalball team at a competition usually moves around jointly through the sports complex, this should have a coherent system of paths and possibly temporarily erected guiding system in order to facilitate

self-orientation for every athlete, for example, after the competition.

For owners of guide dogs for the blind, there must be a way to arrange quarters and running space for the dogs (e.g. dog meadow) without disturbances.

#### ***Flexibility and temporary facilities***

As a rule, dimensioning a competition venue to reserve certain areas for specific users does not appear to be useful. Also the actually necessary number of changing rooms and sanitary units for wheelchair sports can be implemented only partially. However, the emphasis must be on flexibility of use, and on ways to temporarily alter the premises or to deploy mobile units for the duration of a competition.

Essentially, there must be a development system that would meet the additional temporary measures and changes. Planners must pay more attention to door widths, manoeuvring space, turning radii and how vertical development can be organized.

Also the orientation and guiding systems must be customized to different requirements of a competition.

## **5.4. Specific criteria for planning**

### **5.4.1. Exterior accessibility**

The number of parking spaces for people with disabilities is governed by local building regulations, state building regulations and ordinances of the respective communities. In general, it is recommended 1 - 2 accessible parking spaces should be available near the barrier-free entrance.

In the case of training facilities for various types of sports investigated in this project, it is very likely that people with disabilities will require large spaces. Based on the parking place regulations for wheelchair-bound spectators at public assemblies, which stipulate that one parking space must be available for every second spectator, there must be 6-8 parking spaces for each team participating in a training camp. In addition to that at least one parking bay (see Section 4.1) must be provided for minibuses.

It is not necessary to lay out these parking spaces additionally. Solutions for a flexible allocation of parking spaces should be sought in order to use them in different ways through time and organizational planning (also at a competition event).

As described in section 4.1, it will be useful for athletes with severe limitations, as is the case in wheelchair rugby, to cover the alighting area (also from a van).

The pathway to the building must be planned according to the principles described in section 4.1 to enable two athletes meet each other conveniently. It is possible that one athlete or both of them may be pushing their sports wheelchairs in front of them. The path widths must be at least 2.30 m.

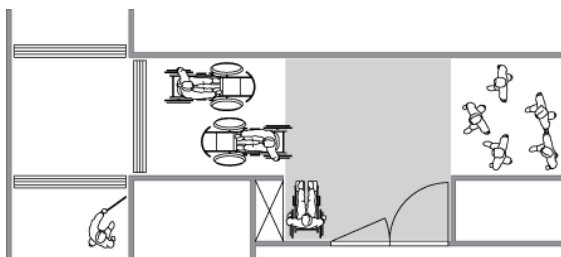
### 5.4.2. Entrance area and interior accessibility

Basically, it would be convenient to organize the relevant service areas on one level. Especially for wheelchair sports managing functional procedures on many floor levels can lead to enormous problems, since many athletes will be forced to change the levels all at the same time.

If many floors have to be used, sufficiently large ramps or lifts must be planned, taking care of possible evacuation contingencies.

#### **Corridors and common areas**

The corridor width is determined by the dimensions of the sports wheelchair or the space required when two sports wheelchairs meet. Since this is mostly about team sports events where simultaneously large number of athletes are expected, circulation areas should always be planned to enable players moving in sports wheelchairs meeting each other or overtaking other wheelchair users anywhere. The corridor width must be at least 2.30 m.



*Fig. 24: Exemplary design of development areas*

For turning, an athlete in a sports wheelchair may generally require a turning diameter of 150 cm. Even turning around one's own axis of 220 cm is possible everywhere if a corridor has a width of 2.30 m. The paths between the individual service areas must be kept as short as possible. Since some of the athletes move on roller boards, thresholds and steps should be avoided (even less than 2 cm) in the area between the changing rooms and sports area.

#### **Vertical development**

As described earlier, any plans for sports halls must rule out the need for lifts as much as possible; but if athlete-specific areas must be accessible by a lift, these must be adequately dimensioned. It is important to note that athletes using standard wheelchairs may take their sports wheelchair along. According to DIN EN 81-70 here only a Type 3 lift is suitable (cage 200 cm wide and 140 cm deep). Although a door width of 110 cm is specified, a door width of 125 cm should be implemented as against the specification.

#### **Construction of doors**

The basic requirements for doors are described in section 4.2. In sports halls and sports halls for multi-purpose use, where oversized sports wheelchairs participate in sports, the door widths are determined by the dimensions of the sports wheelchair. A clear passage width of 125 cm (138.5 cm unfinished) for all doors used by athletes on the way between the main entrance and the play area are ideal:

- Main entrance doors;
- Doors between foyer and general circulation;
- Doors towards the sport hall;
- Doors towards wheelchair storage;
- Doors towards at least one sanitary unit or toilet;
- Doors towards First Aid room.

Since large door widths are relatively difficult to handle and the door technology can be too demanding, preferably less complicated and self-operated systems with a door opener or space-saving or sliding should be used. Also to enable an athlete to push a sports wheelchair in front, automatic door systems may be considered.

Moreover, depending on the processes of training and competition also doors to changing rooms, sanitary facilities or other relevant service areas (such as the space for

doping checks) should be planned with a clear width of at least 117 cm (126 cm unfinished).

The manoeuvring space in front of the doors is determined by the turning diameter of the sports wheelchair. Here dimensions of 150 x 200 cm can be sufficient.

### 5.4.3. Changing and sanitary areas

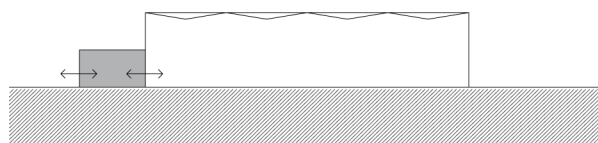


Fig. 25: Optimal location of the changing room and sanitary facilities from the sports area

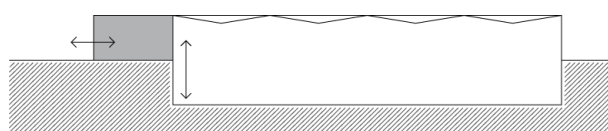


Fig. 26: Possible location of the changing room and sanitary facilities from the sports area that requires intensified developmental efforts

Changing rooms and sanitary facilities should be located on the same level as the sports area. If these facilities are located on another level, appropriate accessibility system must also be planned – here it is important to note that an entire team has to manage changing the level simultaneously.

Important basis principles for planning the changing rooms and sanitary facilities are described in section 4.4, in the general requirements. In addition, the following should be considered:

#### **Changing rooms for teams**

Since all ball games are team sports, not many individual changing rooms are required. The protection of privacy plays a role only in certain situations (change of catheter).

Male and female athletes often practise together as a team. In designing the changing room, the need for at least two changing rooms available for a team must be given due consideration.

In the case of common changing rooms, it is not sensible to make them available only for a specific user group, because flexibility and usability of various premises is more important. The required free space between the benches of 150 cm (or 180 cm, if there is only one passage) agrees with the space requirement of standard as well as sports wheelchairs.

Changing rooms, where change of a wheelchair carried out, require more and sufficiently large space to allow change of a wheelchair besides the manoeuvring space mentioned earlier. When planning a suitable wardrobe, one can assume the presence of 4 to 6 players at the same time.

Some athletes may use a couch conveniently for changing and, as a permanent piece of “built-in furniture”; it should be a general part of a team locker room. The usability of such niches could also be employed in the sense of a *universal design* for the equipment for other sports groups. A couch in the team changing room (if at least not separated by a curtain) is rather unsuitable for changing a catheter. Note that a helper can best assist a severely paralyzed athlete only from the head side of the couch.

The intermediate area between the changing room and the shower room, which is often still wet, should be designed according to recommendations in section 4.4 Flooring.

### ***Sanitary facilities adjacent to team changing rooms***

In the dimensioning of sanitary facilities, planners should assume that two units must be available for each team comprising 4 to 6 athletes. Furthermore, these facilities must provide amenities so that several athletes with standard or shower wheelchairs can use them simultaneously. The installation of multiple folding shower seats and full-length grab rails is considered absolutely necessary. The floor gradient should be level enough for a wheelchair to remain at rest without rolling. The toilet should be accessible from both sides in every changing room. If necessary, single-sided access can also be implemented if an adjacent second group of rooms is planned with an identical mirror-image layout. Furthermore, it can be assumed that the sanitary facilities for the team changing rooms may be used by athletes in sports wheelchairs but only in exceptional cases.

### ***Paralympic basic module***

As described earlier (section 4.4.1), at least one sanitary unit of *Paralympic basic module* should be included as a standard for every sports venue. This unit can be used for changing catheter by athletes who need more privacy. It can also be used as changing room for trainers, teachers or families, and also as place for doping checks. What is important here is the door width which should be at least 125 cm (138.8 cm unfinished); a large sports wheelchair should be able to enter the unit easily.

### ***WC facilities in the entrance and sports hall area***

In the entrance and sports hall area at least one toilet for people with disabilities should be available. Barrier-free access to the two toilet units as specified in DIN 18032-1 should be considered. Two-sided access to the toilets or an identical mirror-image of the toilet units is important here.

The door width should be at least 117 cm (126 cm unfinished) to allow a sports wheelchair.

Depending on the size of the sports complex additional sanitary facilities in the sports area may be necessary. In this case, the solution described earlier must be implemented; however, at least one barrier-free toilet should always be available at the entrance. This toilet need not be meant for use with the sports wheelchair.

### **5.4.4. Storage and equipment rooms**

For storing the equipment used for various types of sports investigated here, areas should be planned in addition to usual indoor sports equipment storage facilities. In addition to balls, net systems for sitting volleyball, goal posts for Goalball and sports wheelchairs for wheelchair basketball and wheelchair rugby will have to be stored here. A point to note is that not all sports wheelchairs can be stacked or hung and, therefore, approximately 1.20 x 1.30 m space must be planned for every non-stackable sports wheelchair.

The storage and equipment rooms are usually accessed directly from the sports area. However, for storing the sports wheelchairs additional rooms can be provided next to the changing rooms or circulation areas. Here the safety of storage of costly sports equipment plays a key role. Separate facilities that are accessible only to authorized people, are often seen as the most favoured solution.

### 5.4.5. Sports halls, gymnastics halls,

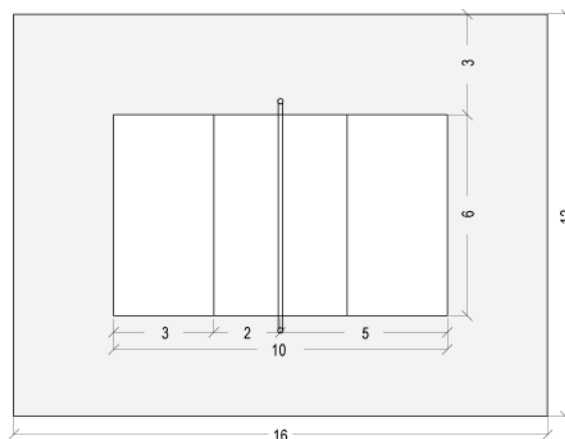
#### **Sports-specific requirements – Sitting volleyball**

For sitting volleyball all sports halls shown in DIN 18032-1 are suitable.

Sitting volleyball is played or practised on a court of 10.00 x 6.00 m. In DIN 18032-1 the necessary markings are not specified. In practice, normally these are drawn temporarily. But drawing permanent indelible corner markers is useful, as they simplify drawing the temporary lines. If the game is held regularly, permanent markings can be considered. Around the field a 3.00 m wide zone must be kept clear. The height of the sports hall must be at least 7.00 m according to the WOVD rules.

The net height is 115 cm for men's teams and mixed teams, and for women's teams it is 105 cm. The net is slightly wider than the playing field – between 6.50 and 7.00 m. For securing the network, basically the following variants can be considered:

- fix a ground-mounted system, developed only for sitting volleyball with sleeves and posts, similar to popular volleyball systems;
- secure the net to the existing and in rare cases adaptable volleyball post; this solution is implemented according to the situation;
- set up a mobile sitting volleyball system which is stabilized by weights.



*Fig. 27: Playing field for Sitting Volleyball, all dimensions in m*

The rules envisage areas for warming up for the players in the sports hall, but outside the free zone of 3 x 3 m. Shortly before the game, the teams can warm up for 6 - 10 minutes on the actual playing area.

For a competition, a single field sports hall is no longer suitable according to the WOVD rules.

During a match, a 4 m wide area on the sideline and at the finish line a 6 m wide area must be kept reserved. The overall size is then 22 x 14 m. All other facilities, such as team benches, etc. should be located outside of this area. The clear height of the hall must be 10.00 m. The field markings must be in white. The net posts must be placed 100 cm from the sidelines.



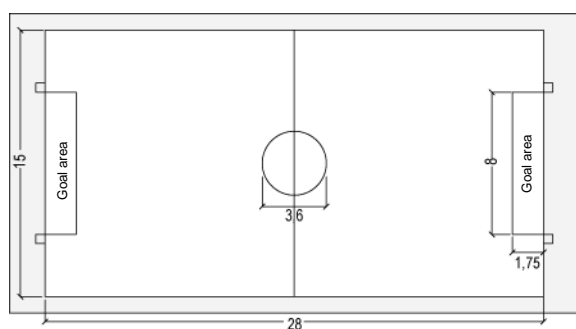


scoring table - as shown in the figure. There should be seven places available for the coach, assistant coach and for the team companion. Players and substitutes use their wheelchairs in the bench area. All other persons must be at least two meters away from the team bench.

As against the markings according to DIN 18032-1 with a black, 5 cm wide line, the IWBF rules prescribe white markings for competitions.

### **Sports-specific requirements: Wheelchair Rugby**

Optimal is also the cross-use of multiple sports hall.



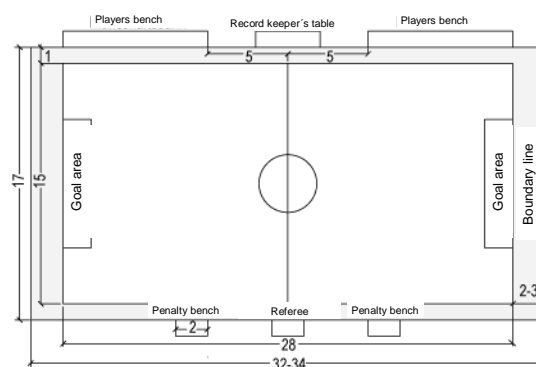
*Fig. 31: Playing field for Wheelchair Rugby, all dimensions in m*

Wheelchair rugby is played on a standard basketball court of 28 x 15 m. According to the rules issued in 2008 by the department for wheelchair basketball, a playing field that complies with the FIBA rules for basketball is also suitable for wheelchair rugby. At the front end, two goal areas (8.00 x 1.75 m) are located, which are defined by floor markings and conical bollards. On the longitudinal side of the sports field, a one meter strip must be kept free; at the front ends at the goal line, nothing is defined. Here enough space is necessary, because the players taking the ball towards the goal can slow down only to a limited degree. If wheelchair rugby is to be practised here, impact protection is important, as required in school sports halls.

The rules do not allow any warm-up time, but in practice a 30-minute warm-up time is allocated. Investigations have revealed that halls separated from the competition venue or areas with training lanes are used temporarily as changing rooms and warm-up areas.

For a competition conducted according to the IWRF rules, the cross-use of a multiple field sports hall is suitable.

During a match, on one side of the sports field temporary areas must be planned for a scoring table, bench and exchange areas, which are marked by lines. The aforementioned distance of one meter should be kept free. The penalty area is on the other side of the court.



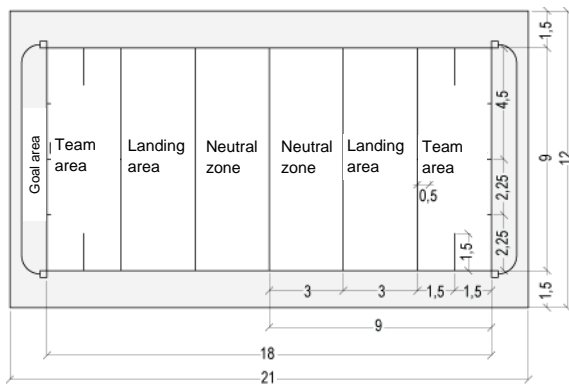
*Fig. 32: Playing field for Wheelchair Rugby at competitions, all dimensions in m*

These requirements result in an area of about 25 x 38 m. None of the basic principles known until now have defined the dimensions for the area behind the goal area or a total size of a sports hall. According to the statements of the representatives of the German refereeing a 2.00 to 3.00 m wide strip surrounding the area would be necessary.

### **Sports-specific requirements: Goalball**

For Goalball, basically smaller sports halls are ideal, because there will not be any disturbance due to noise from parallel activities. For training purposes, a single field sports hall is sufficient.

The playing field is as large as 9 x 18 m and is similar to the volleyball field. Around the playing field an area of 150 cm is marked. If the ball leaves this area, the game is interrupted. The playing area measures 12 x 21 m, and around this area is another clearance area outside. The playing field is divided by baselines into six fields and this is provided with some means of orientation in the team area.



*Fig. 33: Playing field for Goalball, all dimensions in m*

The playing field markings must be clearly visible and tactile detectable; therefore, below the pasted marking strip a tape of 3 mm cross-section is placed (from 2010 according to the IBSA rules reduced to 1.5 mm). The outer line is treated as an exception, which is only visually highlighted. The playing area can be permanently taped only if it does not interfere with the other sports held in the sports hall. The goal extends across the entire width of the playing field front ends (9.00 m) and is 130 cm high. The round tubes of the goal are of maximum 15 cm diameter. When planning a sports facility, it must be noted that some goal systems are anchored to the floor, but normally in practice the goal posts are set up temporarily.

Only goal systems must be used that do not require a mullion.

Investigations during the project have shown that Goalball teams largely emerge from institutions for the blind and visually impaired. Training often takes place in the sports halls of the special schools. Among other things, the following needs to be considered in these sports halls:

- the transition between wall and floor must be clearly visually detectable. If the walls do not have a contrasting design, the same effect is possible through clearly contrasting skirting;
- no sports equipment, doorknobs or similar should project into the hall or items placed at the edge;
- switches, door frames, door handles, etc., should have a contrasting design;
- the impact protection should be enhanced, if necessary;
- instead of impact protection, the size of the sports hall can be slightly larger; and a tactile and visually clearly detectable "safety zone" must be created on the floor. Adjacent to this is another narrow edge zone in which, for example, seats for accompanying persons can be arranged safely.

In the Paralympic games and championships, for each team an area as large as a playing field must be available for warming-up for one hour according to the IBSA rules. Playing fields are considered optimal if the conditions are same as those of competition fields. In this regard, it is important to design also the acoustic conditions on the same lines as much as possible.

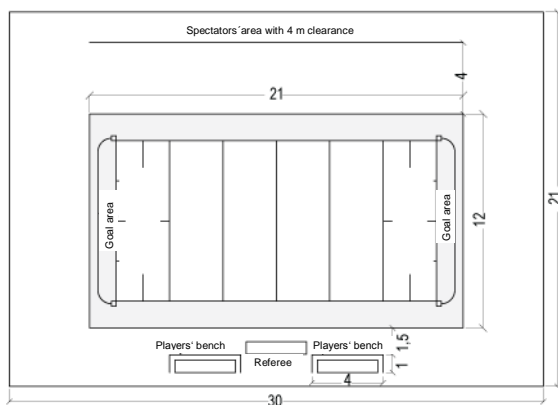


Fig. 34: Playing field for Goalball at competitions, all dimensions in m

For the competition, a single field sports hall is no longer sufficient; a larger sports facility like a three field sports hall must be available. According to the IBSA Goalball Rulebook 2006-2010, the minimum size of a competition sports hall should be 30 x 21 m and with a minimum height of 5 m. Benches for both teams and a referee zone are in this area. Additional equipment, like scoreboard or playing time display, is always defined in the current updated rules.

### **Soil characteristics**

Basically, at competitive games all sports fields for the games and the warm-up zones should have the same soil conditions.

The requirements of the various types of sports investigated in this project range from very different to contradictory. By and large, both sitting volleyball and Goalball have comparable demands, just like those of wheelchair basketball and wheelchair rugby. Therefore, when looking for an optimal solution for a specific sports venue pros and cons must be taken into account.

The suitability of sports hall flooring for wheelchair sports has been investigated in the general tests and requirements and presented in the references. For planning a sports venue, the principles described in DIN 18032-2 and four design principles of the sports floor (area-elastic sports floor, point-

elastic sports floor, combined elastic sports floor and mixed-elastic sports floor) should be examined and considered, depending on their suitability. In this regard, the point-elastic sports floor is unsuitable for wheelchairs, while area-elastic sports floors are more suitable.

According to the IWBF rules, the playing surface in wheelchair basketball must have a visually smooth surface and must either consist of a permanent or mobile wooden floor or synthetic material. For the main competitions of IWBF a permanent wooden floor is preferable.

In the case of sitting volleyball the playing surface must be smooth, flat and uniform. Rough or slippery materials are not permitted. For competitions, the surface details are taken from the WOVD. For competitions, wood coverings or special synthetic materials are permitted. Also in Goalball the smooth surface must be approved by the IBSA. For example, Taraflex was the top layer material approved as the surface material for the Paralympic Games; but it is a point elastic system and considered to be unsuitable for wheelchair sports, as mentioned earlier. In Goalball and sitting volleyball also mobile floor systems can be installed if necessary.

### **Room acoustics**

As discussed already, the requirements for the room acoustics essentially correspond to the standards of a sports hall. In the case of multiple halls, targeted sound-proofing should be considered for the ceiling area near the dividing curtain. In the halls, where the blind and visually impaired often practise sports, additional measures should be implemented, as explained in each case.

#### **5.4.6. Service facilities for competitions and spectator areas**

The requirements for the spectator facilities do not differ substantially from the previously described principles. Some additional requirements are described in the current regulations.

In the case of spectator areas for wheelchair sports, there can be more wheelchair users. Therefore, planners must examine which areas are suitable for this group of users. Also temporary measures, such as raised, ramp-accessible spectator platforms on the sidelines play fields can be considered. In the case of wheelchair basketball the rule-book also specifies that the distance between the spectator seats and the outer edge of the playing field's boundary line must be at least 5.00 m.

In order to enable everyone, including those wearing monocular glasses, a better view of the game, seats for the spectators at Goalball should be as close as possible to the playing area. However, the minimum distance of the spectator area to the 1.50 m line around the playing area must be 4.00 m according to the current rules. The material used for the spectator areas should have sound-proofing properties, temporarily if necessary. Setting up an audio system (verbal game commentary transmitted through headphones to individual viewers) should be considered for Goalball as a regular feature.

As mentioned elsewhere, in the case of a competition, exclusive spaces are required for different functions: rooms for referees, media area, space for doping checks, rooms for classification, VIP area, rooms for leaders of international organizations and so on. These service areas normally do not differ much from those of other sports and are available at a sports venue designed for sport competitions. All of these rooms must be accessible and can also be temporarily set up as a mobile space cells.

## 6. Swimming pools (specific requirements)

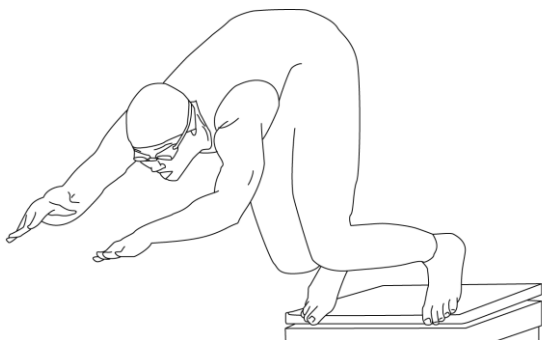


Fig. 35: Diving into water

### 6.1. Swimming

In sports for the disabled, swimming is understandably the most effective field of sports action. While swimming the properties of water can mitigate the functional disorders. Motion improves one's performance as well as the social and motor mobility. The achieved well-being constitutes a prerequisite for long-term social rehabilitation and reintegration.

If swimming competitions of athletes are compared among those with and without disabilities, the difference is almost only in two aspects: for blind swimmers there are "tappers" which touch the swimmer on the head or the back at a turning point or the goal stop with an object fixed to a long rod (e.g. foam material or tennis ball). Furthermore, different starts are allowed, such as sit-start or from the starting block from the water. Moreover, there are some special rules for individual start classes. Paralympic events are organized, like the Olympic swimming events, in an "Olympic" pool of 50 m long and ten lanes which is known as the "FINA standard pool".

The physically disabled swimmers are classified in freestyle, butterfly and back into ten classes (S1 - S10), likewise into ten classes in medley (SM1 - SM10) and into nine classes in breaststroke (SB1 - SB9). In this, 1 indicates the most difficult and 10 the least difficult hindrance. The classification system in swimming has been always evolving and today it is more than just a pure medical classification. Also, the functional abilities of the athletes on land are taken into consideration. For visually impaired swimmers currently there are three starting classes (S11 - S13). Regardless of this, all blind and visually impaired athletes in competitions wear dark swimming goggles. For swimmers with intellectual disabilities, there is the start class S 14 or GB. For this, they must meet the criteria of the assessment scale, which includes, for example, the expert confirmation of an intellectual disability or the need for help and support in everyday life. Suitable classification systems are currently being developed. All athletes who do not meet the minimum standards of a classification system as well as the swimmers with a learning disability take part in the competitions in the category of Generally Disabled.

In Paralympic sports, according to the IPC rules, like in the Olympic competitive sports, no accessories or equipment are allowed. Only swimsuits and trunks and goggles, if necessary, also special incontinence swimsuits are allowed. In no way should the speed, buoyancy or endurance of an athlete be augmented. In rehabilitation, therapy and leisure sports, however, a number of tools are used, such as swimming belts, kickboards, pool noodles, etc.

## 6.2. Sports facilities and game-specific standards and recommendations

Swimming has been following the rules of the International Swimming Federation (FINA) since 1960. Based on this, the IPC formulates additional rules to respond to the needs and opportunities for disabled swimmers. These are enshrined in the IPC Swimming Rules. Currently there are the following rules:

- FINA Handbook 2005-2009: Constitution and Rules,
- IPC Swimming Rules 2005-2008,
- IBSA Swimming Rulebook 2005-2009.

For wheelchair accessible design of swimming pools, basically E DIN 18040-1 must be applied. In addition, DIN EN 15288 deals with the requirements for the design and construction of swimming pools. Among other things, the following additional recommendations are applicable:

- COC Directives for the Construction of Baths, published by the Coordinating Committee for Baths,
- GUV-I 8527 – Floor covering for wet barefoot areas,
- GUV-R 1/111 Rules for Safety and Protection of Health – Safety rules for Baths,
- BGR 181: Flooring in work rooms and work areas with risk of skidding.

## 6.3. Functional procedures in swimming pool

Although swimming covers a wide range of sporting activities, the respective functional procedures are the same. People reach a swimming pool by public transport or personal transport. Except clothing and personal items sports equipment and accessories are usually not allowed for transport. Athletes go through the entrance and waiting area and then head for the changing rooms.

The question is not resolved whether changing from the street wheelchair into a wheelchair meant for the pool should take place at this point. If street wheelchairs are used, the problem is that the wheels become dirty and thus soil the wet area near the pools. Changing from a street wheelchair into pool wheelchair should take place near the cash counter at the entrance, and for the street wheelchairs, a separate lockable room for storage must be provided or they must be supervised by the cash counter staff. Furthermore, there must be a charging facility for electric wheelchairs in this area. The dimensions of the space for the change and parking of wheelchairs are given in E DIN 18040-1: Wheelchair parking spaces are large enough for changing the wheelchair if they have a manoeuvring space of at least 180 cm x 150 cm. In front of the wheelchair parking spaces, additional manoeuvring space of at least 180 cm x 150 cm needs to be considered.

Prostheses are stored either in the changing room or directly at the water's edge.

From the changing rooms, the swimming pool is accessed through the sanitary areas. Some users need instead of swimming pool ladders special climbing aids. Since these facilities are located at the side of the pool, they should be reserved for disabled athletes.

While swimming in the pool, especially in the treatment and rehabilitation sports, devices such as kickboards are used. These are taken by the trainers on a material car to the water's edge.

Regardless of the practised sports, after completing a training session in the water, the disabled candidates leave the pool for which accessories are necessary. They move towards the sanitary areas and the changing rooms.

In swimming competitions, there is no significant difference in the training functional procedures - however, there can be more

people with different disabilities and various aids such as prostheses and wheelchairs. The fact that all athletes should be able to use all changing areas of the swimming pool is particularly evident at competitions.

## 6.4. Specific criteria for planning

### 6.4.1. Exterior accessibility

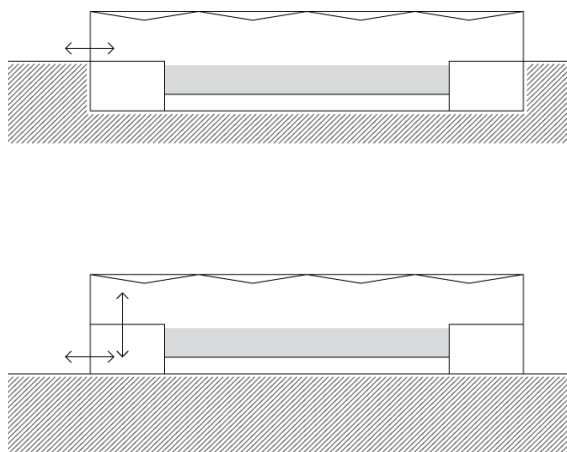


Fig. 36: Methods of integrating a swimming pool into the terrain

How the outer entrance to the swimming pool is designed depends on the building's design. It has advantages to integrate the entire site with the pool's surround at ground level to facilitate access to all user groups; then, there is not need for lifts, stairs or ramps. There will be fewer problems in terms of planning evacuation of people with disabilities since a direct access from the pool's surround into the open area can be implemented.

With regard to parking, there are no special requirements from sports for people with disabilities, since no devices, etc. have to be transported. However, especially with swimming pools, access roads and parking areas for minibuses must be provided to enable athletes with electric wheelchairs or even larger groups of severe multiple disabilities (for example, from a residential care facility) to reach the swimming pool.

### 6.4.2. Entrance area and interior accessibility

The entrance area serves as a meeting point and information area. Also the cash counters are located there. Their desks should be at least maximum 80 cm high in partial areas and wheelchair accessible in a clear height of minimum 67 cm and more than 30 cm. An inductive hearing loop facilitates communication through a hearing device. This should be marked accordingly. A guiding strip or any such design element must be constructed to help the blind and visually impaired people find their way to the cash counter area easily. In addition, areas for the porch, the cash points, waiting areas (with wheelchair accessible tables), cleaning equipment and toilets are necessary.

In swimming pools mainly turnstiles are used as passage barriers. But wheelchair users and disabled people who use crutches cannot use them. Therefore, often additional revolving doors are provided, which are opened by the cash counter staff electronically. One should be able to differentiate these door elements from the fixed elements easily and should always be designed in a distinct colour contrast with a clear marking.

For people with disabilities, the shortest possible path from the changing room to the pool via the sanitary area is ideal. Particularly with regard to competitions, it is useful to design all changing rooms barrier-free (for example, with sufficient passage widths for wheelchair users as well as visual and tactile information for the visually impaired), regardless of whether individual or common changing rooms are provided, or areas for people with disability are specifically designated.

Since swimming sports wheelchairs are not needed while swimming and the shower wheelchairs do not exceed the dimensions of standard wheelchairs, it is enough if doors are designed according to E DIN 18040-1.

In swimming pools, particularly the safety of blind and visually impaired people must be ensured in hallways, in pool surroundings and other recreational areas. Fixtures and temporarily used objects (e.g. water polo goal posts or equipment trolleys) may not be placed even temporarily in the walkways.

The slip-resistant surface materials in the swimming pool must be in accordance with GUV information. Areas where water puddles are formed must be avoided.

*Table 2: Spatial-functional user requirements in swimming sport and their structural implementation*

Initial assumption	Constructional implementation
- users can be of any age and have a wide variety of physical, sensory and cognitive impairments	- apply consistently accessible design, principles of universal and inclusive design, good, intuitive discoverability through central location and easy routing
- often only individual athletes with disabilities are present	- the wheelchair accessible changing rooms should also take into account the specific needs of different user groups (e.g. changing rooms for families)
- in competitions also large groups of people with disabilities are present	- it should be possible to use all changing areas simultaneously: sufficient manoeuvring space and door widths, as well as information for blind and visually impaired are necessary throughout
- safeguarding privacy for some user groups (especially therapeutic and rehabilitation athletes) is particularly important	- besides common changing rooms and shower facilities should be further options for changing rooms and showers should be provided
- some users may require assistance in changing rooms, which can also be done by an accompanying person of the opposite sex (caretaker, spouse)	- neutral accessible changing rooms and sanitary units (Paralympic basic module as described in section 4.4) should be provided - the availability of all accessible changing rooms at competitions are sufficiently separate changing rooms for men and women as well as several common changing rooms feasible

### 6.4.3. Changing and sanitary areas

The COC guidelines provide extensive information about the size of the changing rooms, the number of changing rooms and wardrobe spaces, each always depending on the size of the water surface. The Paralympic basic module (see section 4.4.) is a minimum requirement for accessible changing rooms also for swimming pools. The wardrobe cabinets for people with disabilities must be built large enough (minimum clear width 35 cm, height 110 cm) and without permanent partitions, so that prostheses can be kept there. Furthermore, wheelchair accessible lockers and mirrors and hairdryers must be provided.

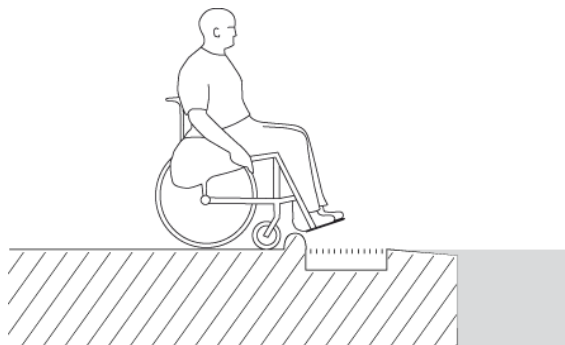
### 6.4.4. Swimming pools

Basically, there is a difference between pools for competitive sports and pools for therapeutic use including pools for recreational purpose. The standards for competition pools meant for competitive sports and Paralympic sports are defined as "FINA standard pool" which must be 50 m long and have 10 lanes with a width of 2.50 m. In addition to the flanks a margin of 0.20 m must be ensured as stipulated by the IBSA for the safety of visually impaired athletes. In competition pools no permanently installed equipment such as stair slides, ramps, etc. are allowed; they can be used optionally as mobile installations. For all other swimming and therapy pools, there are many designs



available which can simplify the usability for people with disabilities. This includes the use of movable floors in variable pools.

While the pool's surround in the case of competition pools mainly serves as a traffic area, the recreational area can be used for other activities like sunbathing and relaxation. The minimum width of the pool's surround in various places are defined in both DIN EN 15288-1 and in the COC guidelines, but they must be extended depending on the importance of the sports facility and the expected number of persons and the rate of expected spectators at swimming competitions. A 3.25 m wide surround between the pool edge and the leading edge of the benches around the area has proven to be the ideal size. Even at competitions several people can stand or sit together and there is adequate manoeuvring space for wheelchair users along the pool. The arrangement of benches (to be designed possibly as warm-up benches) at the edge of the pool's surround is ideal.

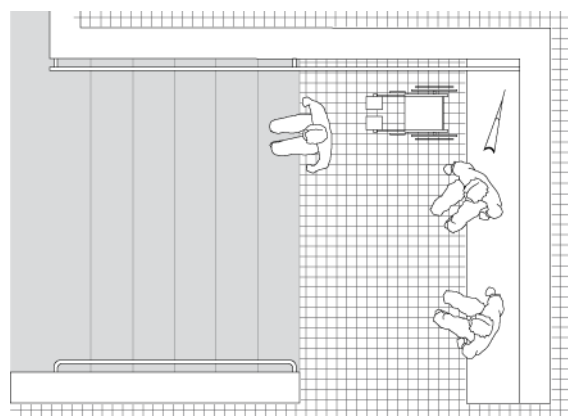


*Fig. 37: Enhancing the safety of wheelchair users; the bump is also palpable by anyone using a long cane.*

In swimming pools, various channel systems are used; they must be selected, designed and implemented also in terms of supporting transfer of physically disabled swimmers into the water as well as ensuring the safety of visually impaired users. For this, around the swimming pool either a well palpable edge or a wide strip in the floor must be made,

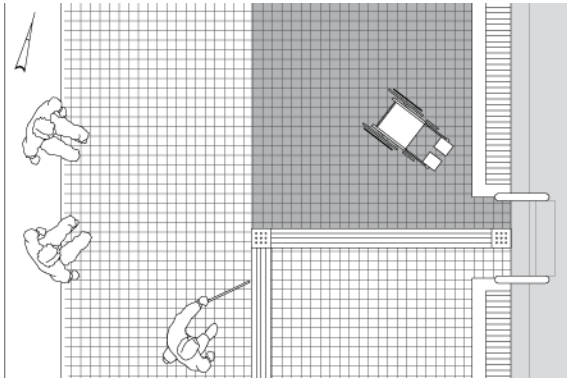
where its shape clearly differs from the rest of the flooring of the room.

When planning the pool's surround sometimes conflicting requirements of blind and visually impaired athletes as well as those of athletes in wheelchairs need to be carefully balanced. Wheelchair users drive up to the entry point into the pool and use either accessories to enter the water or they manage to change even from a wheelchair to the edge of the pool and get into the water from there. In both variants the wheelchair remains standing at the pool edge. From there, it should not roll away, so that the physically disabled athlete can get into it again after coming out of the water. The same applies to those using prostheses: If they have not stored these already in the changing rooms, then, they are kept at the edge of the pool. This creates a hazard for blind and visually impaired athletes, but also for all other pool users. Accordingly, it is advisable to provide a defined space for wheelchairs at the pool edge. In the case of leisure pools there is ample leeway, and a solution, for example, similar to Figure 38 can be planned. A half-high wall forms a border here, where wheelchairs can remain and swimmers slide over flat stairs into the water. At the same time, caretakers or therapists can drive a disabled person with the shower wheelchair into the water.



*Fig. 38: Example of a parking space for shower wheelchairs in recreational and therapy area*

In FINA competition pools this possibility of setting aside a specific area for wheelchair users is not available. However, the blind and visually impaired athletes face same problem of not being able to perceive wheelchairs, prostheses and other aids which are kept at the edge of the pool; at the same time, they should not be removed from the pool edge. A possible solution here is to guide the groups of athletes through intuition to use various areas by structural objects.



*Fig. 39: Example of part of a pool's surrounding areas with zoning the user groups in competition swimming pools*

For example, for wheelchair users a bright coloured box is marked on one side of the pool's surround, where wheelchairs or prostheses can also be kept. In this area also other technical aids used for entering into the water should be kept. Blind and visually impaired people, who follow a tactile detectable bright coloured guiding strip, are not led into this area. They can enter this independently and, for example, follow the channel system there. Since there is no guiding system available, as against the other areas of the pool's surround, they must be cautioned that the walkway here is unsafe.

#### **6.4.5. Other rooms**

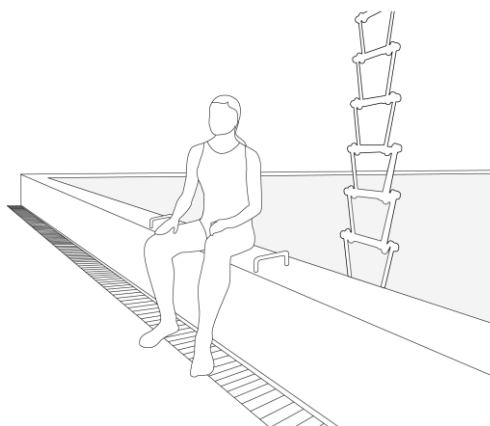
Barrier-free accessibility and usability of any existing power and fitness rooms must be ensured. In rehabilitation and therapy sports, storerooms with shelves and manoeuvrable

space for material handling vehicles (dimensions 140 x 60 x 175 cm) must be available.

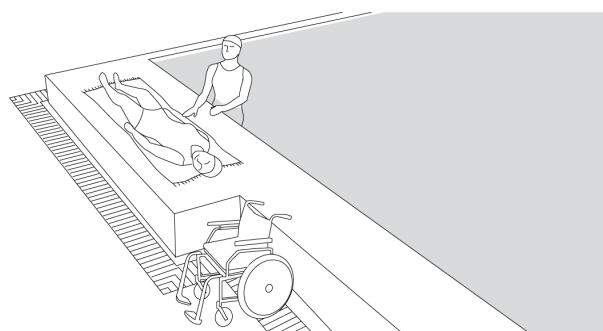
#### 6.4.6. Devices for entry into the pool

The following illustrations show some currently typical devices for entry into the pool.

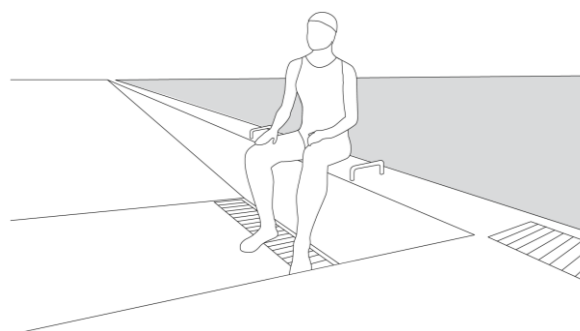
*Fig. 40: Raised pool's edge, as the case may be, in combination with lifting platform. Athletes can shift themselves from the wheelchair to the edge of the pool and independently enter and leave through this. Handles on the edge of the pool can be of help. To come out, a bar in the pool or a suspended rope ladder is helpful.*



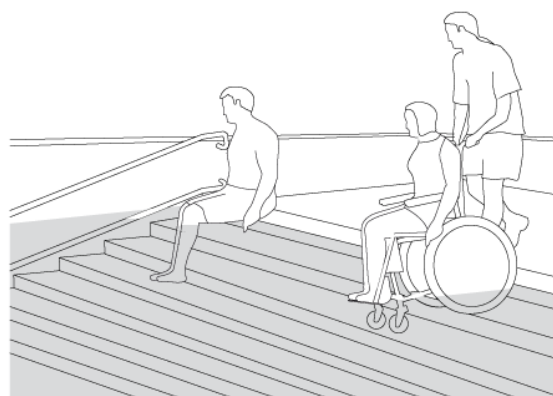
*Fig. 41: Enlarged pool deck. The wider contact surface at the edge of the pool is used primarily in the area of rehabilitation. With staff support quadriplegics can smoothly enter into and exit from the water. For paraplegics and amputees, this solution can facilitate independence.*



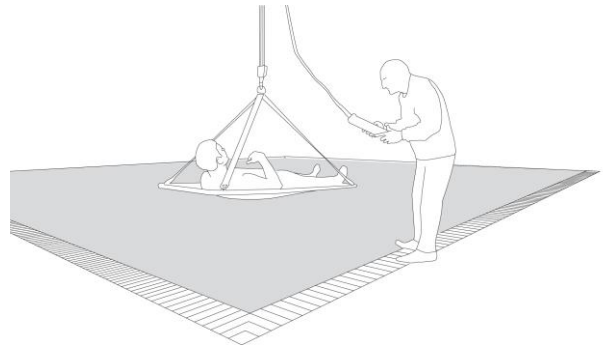
*Fig. 42: Combination "Finnish channel" and "St. Moritz channel" The pool's surround is slant in one section and can be approached using the wheelchair via a ramp (slope 6% max.) There, the athlete can shift himself to the edge of the pool and get into the water. This part of the pool is implemented with the system of St. Moritz channel.*



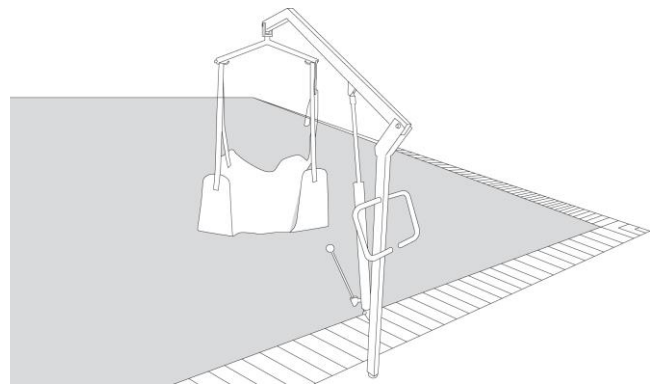
*Fig. 43: Low-level steps. In the area of recreational, leisure and rehabilitation sports, this is a preferred solution. The athletes can independently slide into or out of the water in sitting position. Handrails on both sides provide security to persons walking or standing. Wheelchair users may also be transferred by a helper along with the shower wheelchair into the water.*



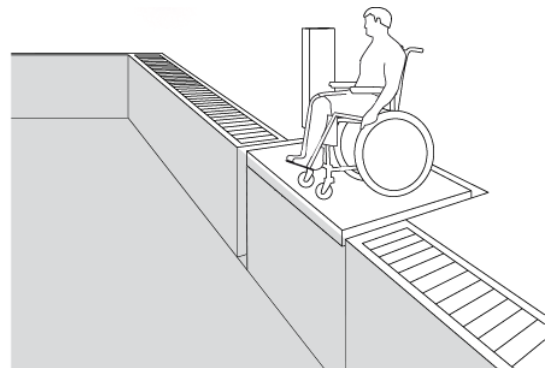
*Fig. 44: Gantry and stretcher. In this combination, also people lying can be shifted into the water (to be used mainly in the treatment and rehabilitation area).*



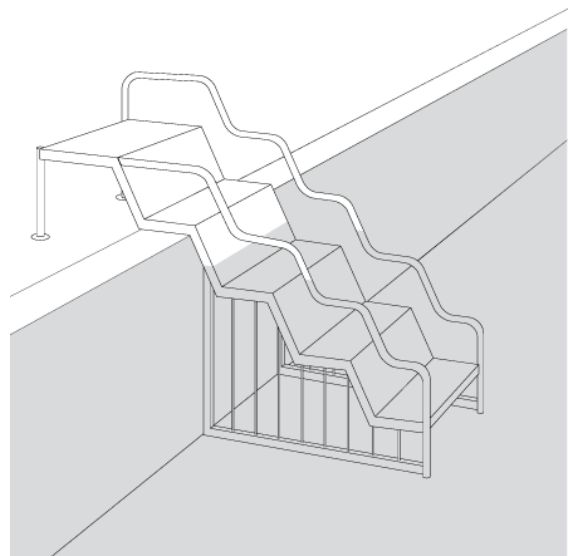
*Fig. 45: Swimming pool lifter. This is suitable for lifting in and out of wheelchair users who have limited arm strength. Equipped with a cloth or even with a seat and operated hydraulically or electrically. The user should be able to use it independently. A disadvantage of this solution is the public view of the athlete.*



*Fig. 46: Dive platform. A movable platform is operated by the swimmer himself, an accompanying person or the lifeguard. The athlete can dive with the shower wheelchair into the water and begin to swim without assistance. To leave the water assistance (provision of wheelchair, operation platform) is necessary.*



*Fig. 47: Mobile entry stairs. This is suitable for entry and exit for athletes with well-built arms and hands. As a mobile element suitable also for competition pools, but is a heavy structure with complex handling and must have sufficient storage space.*



## 7. Ice Sports facilities (specific requirements)

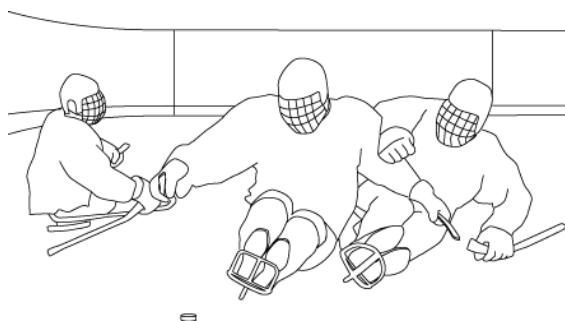


Fig. 48: Ice Sledge Hockey in action

The specifications for the construction or conversion of ice rinks shown are derived by using an Ice Sledge Hockey field. Where it differs from hockey is shown since obviously both games can use this facility.

### 7.1. Ice Sledge Hockey

In this sport, there is an alternative to ice hockey for athletes with physical disabilities who cannot use skates because of their disability. This powerful sport is no way inferior to hockey in its dynamics. The athletes move at great speeds on custom-made sledges with the help of two short clubs across the ice. The aim is to hit the puck into the opponent's goal. Even the playing field and the rules have been adopted from ice hockey and partially modified.

According to the IPC Ice Sledge Hockey Rulebook a team consists of maximum 13 players and 2 goalkeepers. With the integration of at least one woman into the team, the team size increases to 16 players. During the game maximum 5 players and a goalkeeper are allowed on the ice from a team. Non-active athletes remain sitting on the team benches in sledges and may be substituted for the active athlete. The game time is 3 x 15 minutes.

In Ice Sledge Hockey, there is no actual classification system. According to the rules and regulations of the IPC, all athletes must have impairment in the lower body, which is apparent and makes normal skating or ice hockey playing impossible. In the upper body normal functionality is a condition. In all a large number of wheelchair users can be expected, and considering the required absence of any impairment of in the upper body of a sportsman, the use of electric wheelchairs is ruled out.

The sports equipment for Ice Sledge Hockey is derived from the ice hockey and adapted to the needs of athletes with disabilities. The exact construction method and the maximum dimensions permitted are described in the IPC Ice Sledge Hockey rulebook. To move forward the athletes use special *sledges* which are fabricated individually for each player and by which they go in a sitting position on the ice. These sledges consist of a steel or aluminium frame and are designed with specially designed seats and leg fixation facility for the athletes; therefore, their dimensions are very different. Sledges for double amputee players are, for example, shorter than the sledge used by athletes with paralysis. The maximum length of the carriage can be assumed to be about 1.20 m. The maximum seat height is 20 cm above the ice surface according to IPC. The maximum overall height of the sledge is not prescribed and depends on the height of the seat shell. The widest part of each sledge is the seat so that the maximum width is determined by the seat width of the athlete. For locomotion and play there are two short bats, to the ends of which spikes are attached. The rounded end is used for guiding of the puck. The players' sticks have a maximum length of 1 m. The goalkeeper's sticks are different from those of the other players. The *puck* in ice sledge hockey is not different from ice hockey. Besides the actual sports equipment, athletes need *specific sports clothing* to prevent injury. This includes, among other things, a helmet, face

mask, throat protector, protectors and gloves.

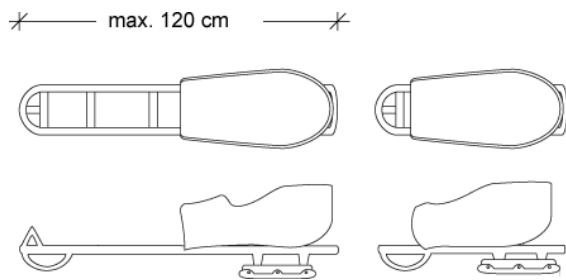


Fig. 49: Examples of sledges in outline and side view

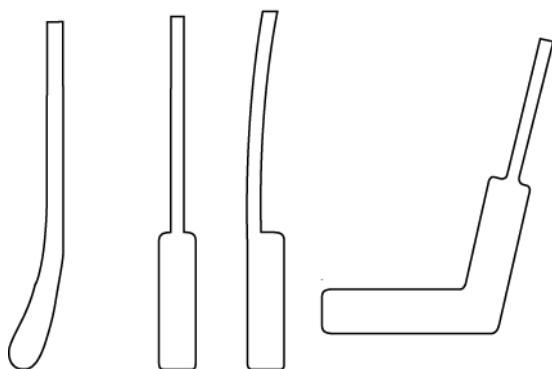


Fig. 50: Sticks for players (left) and stick variants for goalkeepers (2, 3 and 4 from left)

## 7.2. Sports facilities and game specific standards and recommendations

The rules of Ice Sledge Hockey are very similar to those of hockey and are published by the IPC:

- IPC Ice Sledge Hockey Rulebook 2009-2010,
- Technical Requirements for the 2009 IPC Ice Sledge Hockey Paralympic Winter Games Qualification Tournament,
- IPC Ice Sledge Hockey Regulations 2009-2010.

Primarily E DIN 18040-1 must be implemented for barrier-free design of ice sports facilities. In addition, the following construc-

tional standards and recommendations also apply:

- E DIN 18036:2008-03 Ice Sports facilities,
- DIN EN 12193 Lighting and illumination – Illumination in sports facilities,
- VDI 2075 Ice Sports facilities – Technical building installations.

## 7.3. Functional procedures in ice sports facilities

In general, athletes keep their sledges in the ice rink. However, wheelchair athletes can also transport their sledges themselves. The sports equipment can be placed, for example, on the wheelchair's running board and held by one hand. Similarly, the sledge frame can be used to hang the sports equipment around the neck. Since the sledge is transported in the vertical position, there are no additional requirements for the passage width of the doors at the ice rink. For the transportation, the sledge may be equipped with a skid protection; therefore, there is no risk of injury. For storage, the sledges can be stacked.

Most athletes take home the protective equipment and general sportswear, sometimes also the stick, for cleaning and airing after training or game. However, a possible reason for the transportation can also be the frequent lack of storage facilities for the equipment. For the transportation of sticks and protective clothing, a very large sports bag is required; this can be transported by wheelchair users by placing it horizontally across the wheelchair. Alternatively trolley bags are used, which can be pushed around by the athlete. Due to the bulky luggage, the athletes are limited in their mobility and operation of heavy doors, and passing through the narrow width is cumbersome.

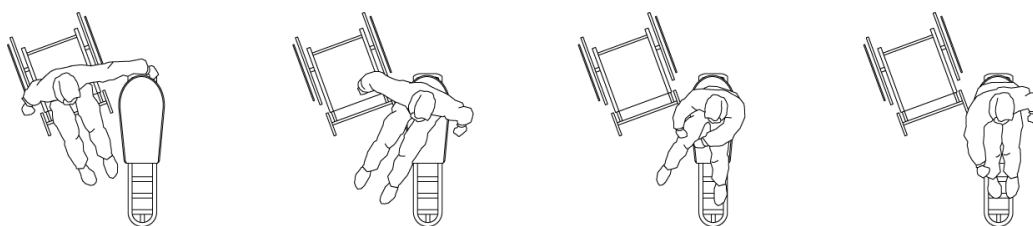
The equipment is carried between the storage and ice surface areas usually by those walking the way, for example, the trainer,

because the sledges can be stacked in the storehouse up to a height of about 2.00 m and storage areas are often provided with minimal manoeuvring space. For the transportation, trolleys have proved to be practical, on which the sledges are stacked and on which they can be kept straight up in the storage room outside of training times.

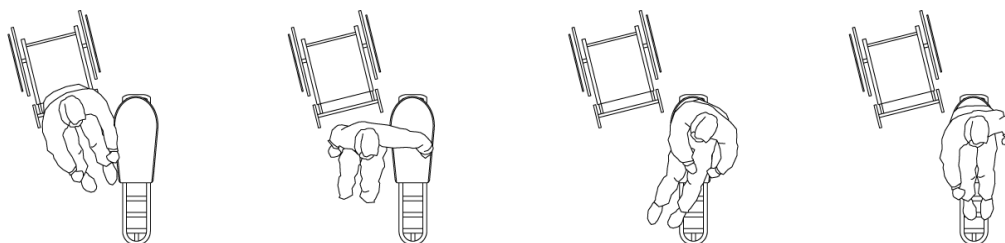
One can move about comfortably with an Ice Sledge only on ice or on sliding surfaces, as needed in the team areas on the ice surface; hence, these areas can only be used with

the sledge. For all other areas, one must leave the sledge and change into the wheelchair. It is a contradiction to use a sledge on the non-skidding ground in the changing area of the ice surface. Here only short distances are possible.

Shifting from the wheelchair into the sledge is, therefore, done after the changing room directly on the ice surface or on the ice itself. For this shifting, about 1.60 x 2.00 m of space may be needed (see diagrams below).



*Fig. 51: Direct transfer from wheelchair into the sledge*



*Fig. 52: Indirect transfer from wheelchair into the sledge in knee position*

The sledges are given to the athletes by their escorts and the standard wheelchairs are removed from the ice surface again if necessary. After shifting into the sledge the athletes go into the team area or to warm up on the ice. During practice or game, the wheelchairs remain on the edge of the ice surface, near the team area or the used ice entrance. Appropriate parking areas must be available. The area required depends on the number of approaches to the ice, the composition of the team and the type of hall use

merely as a training facility or for taking part in competitions. In each team a maximum number of 16 wheelchair users can be expected. It is important that the area around the ice is usually an escape route and the corresponding passage widths should not be obstructed by parked wheelchairs.

Alternatively, it is also possible to prepare the path from the changing room to the ice surface temporarily with plastic floor panels, on which skates can be used. In this way

players can change into sledges even in the changing room.

Athletes with amputations come with prostheses and / or crutches or a wheelchair for training, where the latter variant is the preferred choice for athletes with amputation on both limbs. How the prostheses handled is very individual. Firstly, it should be possible to stow the prosthesis safely in the changing area, then hop on one foot to the ice surface with crutches or the wheelchair. Another variation is to take off the prosthesis directly at or in the team area before getting on to the sledge. In this case, storage facilities should be provided in the team area.

Access to the ice is through the doors on the boards, which can be operated traditionally only from the outside. To avoid injury and damage no handles or other control elements are mounted in the inside of the boards. Anyone standing can approach the boards and open the doors from the ice side automatically. Athletes sitting in the sledge on the ice cannot do this. The athletes, therefore, depend on those walking outside the ice surface to open the doors for entry or exit, but this is usually ensured during training and competitions.

The functional procedures in the competition are very similar to those during training sessions. The difference is that there will be more players and, therefore, more wheelchair users can be expected. Moreover, the fact must be borne in mind that guest players must carry their entire sports equipment into the sports complex themselves.

## **7.4. Specific criteria for planning**

### **7.4.1. Exterior accessibility**

Most of the athletes come with their own car for training, since a wide range of sports equipment needs to be transported. Therefore, a large number of wheelchair-accessible parking spaces must be provided. This applies particularly to facilities for hosting competitions.

As mentioned earlier, to facilitate easy access for the athletes coming with large baggage to the ice rink automatic door openers must be fixed on the entrance doors.

### **7.4.2. Entrance area and interior accessibility**

The main connecting pathways for the athletes of ice sledge hockey in ice sports facilities are between the accessible parking spaces, the changing area, the ice surface and the storage room for sports equipment. For all important sequential spaces used by athletes a clear and short routing is recommended in principle. A direct access from the parking lot to the ice rink is advantageous to facilitate transportation of sports equipment on a short path to the ice surface.

The ice rink is in areas, which are accessed with skates, must be laid out with a slip-resistant, durable and skate-friendly material according to E DIN 18036. This applies mainly to the traffic area around the rink as well as ways to the changing rooms and possibly the changing rooms themselves. For using the ice rink for Ice Sledge Hockey, therefore, adjustments to the flooring in the team areas are necessary; these are explained in section 6.4.4 in detail.



All rooms used by athletes and officials must have a door opening width of at least 90 cm in order to ensure accessibility for wheelchair users. Since complaints are likely after a game, the referee rooms or announcer booths must be accessible. The draft version of E DIN 18036 prescribes an impact-resistant construction in the lower section and an opening width of 105 cm for all the doors that are accessed with skates and / or hockey outfit. In the Appendix D, which summarizes the concerns of disabled compatible ice sports, the standard requires a clear door opening width of 100 cm for the changing rooms and sanitary rooms. Doors should open outwards and unlock from inside. Automatic door openers are recommended.

#### **7.4.3. Changing and sanitary areas**

Since most ice rinks are used by various groups (sports teams, individual athletes), usually several changing rooms are maintained which can be used individually. Changing rooms for team sports are usually the common changing rooms without lockers. The wardrobe is secured by locking up the entire team cabin. The exact configuration of the changing room is described in E DIN 18036 in Appendix C. For figure skating, ice hockey and speed skating, a common changing room with benches and coat hooks may be provided. Here, a total length of 21 meters per changing room is required. The basis for calculation is 80 cm seat width for players and 100 cm for goalkeepers. The required seat depth is 45 cm and the seat height is 40 cm. The minimum distance between two benches is 250 cm. The prescribed changing rooms are generally used for Ice Sledge Hockey teams, but the provided seat width of 80 cm is too small and inconvenient for wheelchair users. However, if the seats are not partitioned into individual seats, the athletes will not face any restrictions since the teams in Ice Sledge Hockey are relatively smaller. Partitioned benches should not be less than a niche

width and a single seat width of 120 cm for comfortable use by wheelchair users. In this solution, bulky sports bags can be kept under the bench. A bench length can be 240 cm to be used by 3 hockey players or 2 Ice Sledge Hockey players. Moreover, E DIN 18036 describes in Appendix D the necessary equipment for changing rooms for disabled-friendly ice sports, which is explicitly referred to at this point. Here wheelchair storage facility is required directly adjacent to the changing room. For Ice Sledge Hockey, this is not absolutely necessary, since changing from the wheelchair into the sledge takes place directly on ice and the sledges are carried by the coach or accompanying persons from the storage to the ice. For the Paralympic competitions the IPC calls for a changing room of approximately 80 m<sup>2</sup> for every participating team. For every changing room a shower area with at least 6 showers and 4 shower chairs, at least 3 toilets, a trainer room of 10 m<sup>2</sup>, a massage room of 10 m<sup>2</sup> and a storage of 10 m<sup>2</sup> should be assigned.

For the wheelchair accessible sanitary areas, E DIN 18036 demands accessibility without thresholds directly from the changing room. The size of shower areas is indicated as 90 x 130 cm with a maximum gradient of 2%. In the shower area of a changing room for teams, at least two shower seats should be provided. According to E DIN 18036, two wheelchair accessible toilets with washbasin must be allocated to every changing room.

It is recommended to provide at least two changing cabins with the sanitary facilities as stipulated above and, thus, enable their use by Ice Sledge Hockey teams. The possibility of integrating individual female players into the team has particularly highlighted the importance of the Paralympic basic module.

#### 7.4.4. Ice floor

Ice Sledge Hockey is played on a standard ice surface of minimum 56 x 26 m and maximum 61 x 30 m, as is customary for ice hockey.

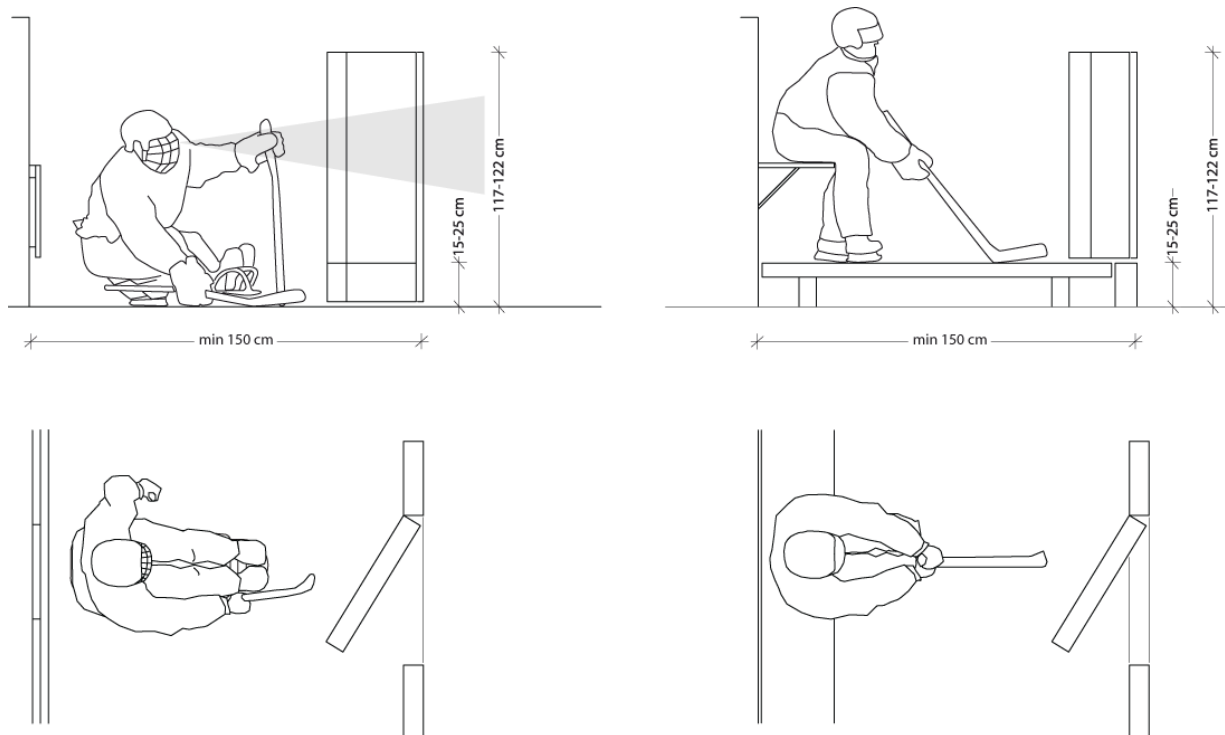
The alignment of team games with hockey and ice sledge hockey sports requires that the team areas are available directly on the ice surface, separated by doors. For example, to ensure a multifunctional hall for individual skating, it will be useful to construct these areas as a passage. This can be achieved by a possible opening of these doors along the entire depth of the team areas. Doors must not have thresholds.

The IPC assumes in its Ice Sledge Hockey Rulebook that the team areas are used by up to 16 players in the sledge team and 6 team members. In all the present regulations, a minimum team area of 1.50 x 10 m is indicated. According to E DIN 18036 sitting benches in the team area should have a minimum length of 10 m and a seat depth of 40 cm. Since Ice Sledge Hockey players in this area sit in the sledges these benches are used only by the accompanying persons. Therefore, a design must be chosen for benches that does not cause any hindrance to the athletes in the sledge in their movements. Recommended designs are structures that are anchored in the rear wall and require no supporting feet. If seats are foldable the manoeuvring space in the team area can be increased further.

The low visibility level of the athletes in the sledges must be taken into account in the construction of the boards, hence “windows” must be provided on the boards according to the E DIN 18036 and the IPC. Fully transparent boards would be generally preferable, but they can be very expensive.

The IPC calls for equal level access from the team area to the ice surface. This demand is a contradiction to the requirements of the Ice Hockey. Here an increased formation of the team area as against the ice surface is required to allow an overview of the playing area to seated players in the team area. In addition, the boards can be easily overcome due the difference in height, allowing for a rapid response to the game.

The difference in the level between the team area and the ice surface in Ice Hockey is not mentioned in the relevant rules and regulations and may vary. However, it is common to arrange the team areas at the height of the kick bar which ends 15 to 25 cm above the ice level. To allow the use of an ice rink for Ice Hockey and Ice Sledge Hockey, employing a mobile construction is possible, which can be adjusted into team areas for ice hockey games. This requires a two-part design of doors in the team areas to achieve an adjustment to the levels of height.



*Fig. 53: Ice Sledge Hockey player in the team area at ice level (left); Ice Hockey player in the elevated team area (right)*

Also with regard to the floor covering in the team areas there are contradictions within various sports.

Whereas a skid-resistant lining is necessary for Ice Hockey, the IPC calls for “plastic ice” or equivalent material for Ice Sledge Hockey as flooring which allows locomotion with the sledge. All other sports also require a non-skid and skid-friendly flooring in the surrounding area of the ice surface. Thus a lining change is necessary at the ice level height alternately for Ice Sledge and, for example, for figure skating.

E DIN 18036 requires two penalty boxes, which are located opposite the team areas, with a bench length of at least 4 m and a seat depth of 40 cm. For the penalty benches for the Ice Sledge Hockey, the same requirements apply as for the team areas.

#### 7.4.5. Other rooms

Ice Sledge Hockey players store their sledges usually in a room in the facility. This room should have a minimum space of 10 m<sup>2</sup>. A point to note here is that carts are used for transportation if the pathways between storage and ice are too long. Appropriate shelves and clear door widths (minimum 90 cm) must be provided in the storage area.

Storage facilities for other sports equipment are recommended. It will be a huge relief for the home team of an ice sports facility, for example, if storage areas are right next to the changing rooms where protective clothing, helmets, sticks, and even the sledges can be stored. This can minimize the transportation of bulky and heavy equipment.

#### **7.4.6. Service facilities for competitions and spectator areas**

If facilities for warming up on the ice surface cannot be provided at competitions for organizational reasons, at least a separate warm-up area must be available. This need not be an ice surface. For Paralympic events, the IPC requires a stretch and warm-up area, which can be used by all teams. The IPC gives examples to equip this area with ergometers and exercise mats or hand-bikes and exercise mats. For the latter option, a minimum space of 425 m<sup>2</sup> is specified.

In regard to spectators, especially in Ice Sledge Hockey there can be more wheelchair spectators. At tournaments, it may be necessary to provide wheelchair accessible spectator seats for a host of teams. When planning of new ice sports facilities, therefore, it is essential to ensure accessibility of spectator stands for wheelchair users. Appropriate spectator seats for wheelchair users must be provided with assigned seats for their escorts. An alternative option for existing ice sports facilities where accessibility of spectator stands for wheelchair users is not provided, the temporary arrangement for wheelchair spectators would be directly at the ice surface. The boards here may obstruct the view for people in wheelchairs. Mobile levels may be the solution which can be erected at competitions around the ice surface. This height difference can be overcome by a ramp or a lift or elevating platform. This mobile structure should not block the escape route width or itself become a fire hazard.

## 8. Athletics facilities (specific requirements)

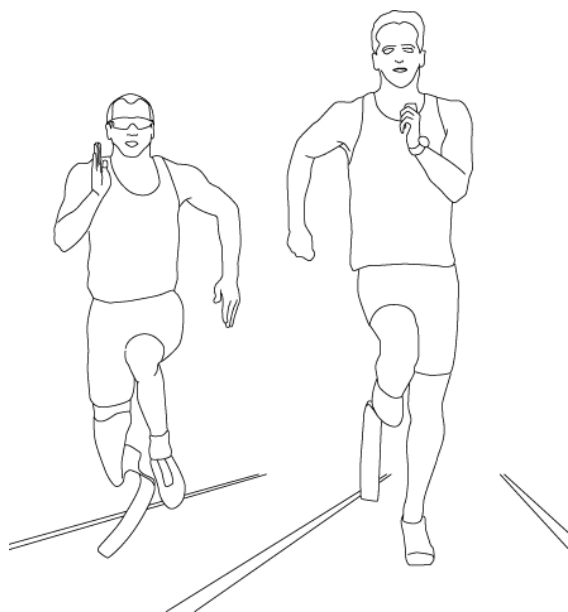


Fig. 54: Sports prostheses in track events

Athletics facilities differ in their overall construction and are categorized into sports fields, stadia and athletic halls according to the visitor seating arrangement and the building shell.

### 8.1. Practised disciplines

Athletics is one of the most important individual sports activities for people with disabilities. Due to the wide variety of disciplines they appeal to a large number of athletes belonging to different groups of disabled people. This is reflected especially in the number of starting classes. Due to the high and ever-increasing levels of performance in the area of competitive sports in the backdrop of technical advancement in the field of sports equipment and prosthetics, athletics is becoming increasingly attractive for spectators.

Athletics is traditionally one of Germany's school sports and is anchored in the curriculum with disciplines such as sprinting, long-distance running, long jump and high jump and shot put. Even in special schools attempts are made to implement these sports.

Likewise, athletics is significant in extra-curricular sports. It has been proved that it is quite possible to introduce even children with disabilities to sports.

Basically, track and road events, field events and the combined events can be differentiated in athletics. The IPC summarizes the Paralympic disciplines as follows:

- Track events: short-range (100 m, 200 m, 400 m), middle distance (800 m, 1,500 m), long distance (5,000 m, 10,000 m), relay races (4 x 100 m, 4 x 400 m);
- Road races: marathon;
- Jumping competitions: high jump, long-jump, triple jump;
- Throwing competitions: discus, shot, javelin, mace;
- All-round competitions: pentathlon.

The conditions in the various disciplines, such as the weight of the throwing devices or the authorized accessories in their design vary widely according to the degree of disability of the athletes in order to adjust to their different physical conditions. Moreover, not all disciplines are offered for each start class. Moreover, in the case of Paralympic Games only those disciplines are pursued, for which a corresponding number of participants is achieved. Therefore, it is possible to allow athletes of different starting classes compete together. In such cases, the appraisal is according to point systems.

### 8.2. Sports facilities and game specific standards and recommendations

The classification of athletes for athletics is complex in view of the large number of types of disabilities. The classification system is governed by the IPC or the international professional associations according to the disability. The following rules are made for athletics for people with disabilities:

- IAAF (International Association of Athletics federations) Competition Rules 2010-11,
- IAAF (International Association of Athletics federations) Track and Field Facilities Manual 2008,
- IPC (International Paralympic Committee) Athletics. Official rules and regulations for IPC athletics competitions 2008-2009,
- IWAS (International Wheelchair and Amputee Sports Federation) Official Rules for Athletics (2006-2007),
- IBSA (International Blind Sports Federation) Athletics Rulebook 2005-2009,
- CPISRA (Cerebral Palsy International Sports and Recreation Association) Sports Manual, 10<sup>th</sup> Edition, 2009, Section B – Sport Rules – Athletics
- DLV, ÖLV, SLV: International Competition Rules (IWR) 2009.

For designing wheelchair accessible athletics facilities, basically E DIN 18040-1 should be followed. In addition to this, the following construction standards and recommendations also exist:

- DIN18035-1 Sports Facilities: outdoor facilities for games and athletics
- International Association for Sports and Leisure Facilities (IAKS): Fundamentals of planning "Sports Facilities / Stadia" 1993

### **8.3. Sports equipment and accessories**

In many disciplines of athletics, in the field of sports for the disabled, special sports equipment customized to individual athletes is necessary. In each case, the type of approved accessories and sports equipment depends on the type of disability, and is strictly regulated by the IPC and the relevant competent professional associations. In particular, major technological advancement in material-intensive disciplines of athletics has contributed to a growing popularity and appeal of the Paralympic Games.

#### ***Racing wheelchairs***

Racing wheelchairs are high-tech sports equipment individually tailored to an athlete. They differ significantly from standard wheelchairs and undergo constant and rapid development. While the early 4-wheel racing wheelchairs resembled the standard wheelchairs, today three-wheeled wheelchairs have become more popular. They are made of lightweight materials as much as possible and adapted in their proportions to the body size, seat position and weight of the athletes. Therefore, today there are no standard dimensions for racing wheelchairs and there is a certain variability of this sports equipment. The width of race wheelchairs depends on the athlete's seat width and the inclination of the wheels. The current standard seat widths range of up to maximum 44 cm. A maximum camber of currently 14° would result in a width of 94 cm. At present, the maximum length of the racing wheelchairs can be assumed to be about 195 cm, while a trend towards shorter and shorter racing wheelchairs is noticeable.

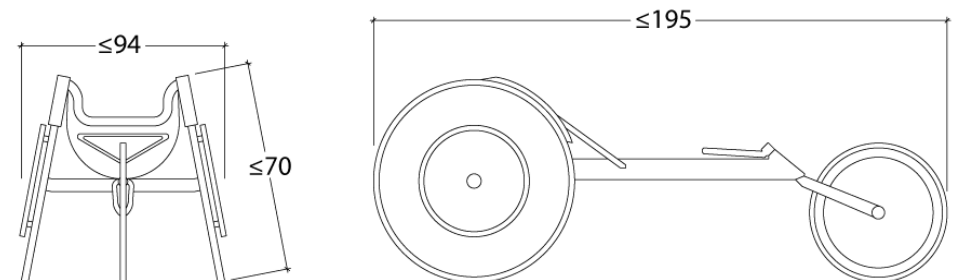


Fig. 55: Front and side views of a racing wheelchair, dimensions in cm

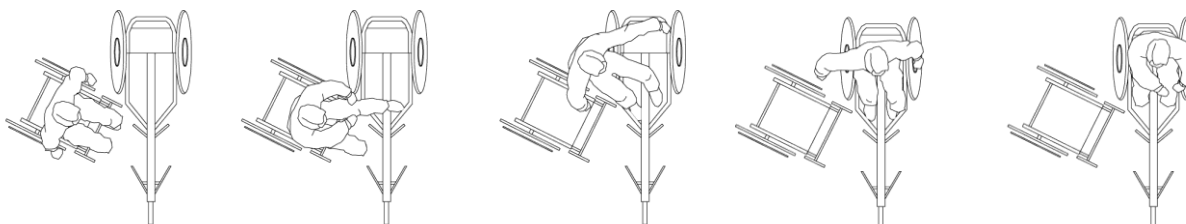


Fig. 56: Shifting from every wheelchair into racing wheelchair

### Sports prostheses

Sports prostheses also belong to the high-tech products in the sports equipment. The prostheses are used as substitutes for missing limbs in athletes with dysmelia or amputations; especially lower limb prostheses play an important role. Prostheses are as individual as the athlete him/herself and are specifically adapted to their disability, physical condition and the applied discipline. Sports prostheses are fundamentally different from a standard prosthesis so as to be able to respond to the changing movement sequences, and are exposed to notably higher stress. Moreover, there are large differences within the sport prostheses. In athletics, a distinction is made mainly between running or sprinting prostheses, of which mostly those with relatively soft resilient carbon spring constructions have become popular and which are also used in the jumping events, and prostheses in throwing disciplines which are equipped with harder spring designs or even prosthetic feet.

### Throwing frames

Throwing frames are devices for wheelchair users to pursue throwing events. Since the 1990s, no wheelchairs are used in the throwing events, because the throwing frames are more robust than wheelchairs and can be fixed in a stable position. They are custom-made for each athlete and are made of metal, fibreglass or similar materials. Many throwing frames are very heavy and cumbersome and are therefore equipped with small wheels to facilitate transportation. According to the IPC specifications, throwing frames may not exceed a maximum height of 75 cm, including the seat cushion, and should not have flexible elements or joints. Many throwing frames have a grab bar that helps the athletes stabilize and balance the lack of trunk muscles during the throw. The IPC does not provide more information about the characteristics of throwing frames, with the result that these sports devices present a very inhomogeneous appearance.

### **Guidance for orientation**

Blind and visually impaired athletes need guidance for self-orientation. This can be provided through personal assistance, such as through guides or callers; this can be implemented through elements like guide ropes and footfall tracks or other technical devices.

#### **8.4. Functional procedures in athletics facilities**

Athletes change from a standard wheelchair into the sports wheelchair during training directly at the track and usually without assistance. The standard wheelchairs remain on the edge of the track and may need weather protection. Racing wheelchairs are usually not disassembled and can be transported by car. Athletes often practise at different places, which means, that transportation of the sports equipment, is required regularly. The ability of the athlete to unload the racing wheelchair independently from the car or to load into the car and to transport it from the vehicle to the competition venue varies depending on the severity of the impairment of the athlete. In any case, the paths between the parking area and the sports field or between the storage point and the sports field must be as short and barrier-free as possible.

Disabled athletes change from the standard prosthesis into sports prosthesis either in the changing area or directly on the track or at the venue. Since the use prostheses in technical disciplines is optional for the athletes and the sport prostheses completely vary for different disciplines, prostheses can be changed, removed or worn also on the field. For changing the prosthesis, seats are required; these can be used for longer waiting times and also for resting. The standard prostheses remain during *training* often right on the track. Benches with appropriate shelter can be used for keeping the prosthesis. Due to the small number of persons during the training security is not so common. At

the time of *competitions* standard prostheses are carried in many cases by an escort from the start to the destination, where changing to standard prosthesis takes place. It is also possible to change the prosthesis in the changing area. In this case, security is necessary for the expensive and individually fabricated prostheses. When dimensioning the lockers this should be taken into account.

The throwing frames are usually kept at the place of training, but they can be transported, for example, by a car for competitions. But overall they are often very bulky and difficult to handle; this means that a storage facility should be available next to the throwing area. Before a *training session* the chairs are brought by the coach or an assistant to the sports field and set up. During *competitions* the organizer often provides a team of helpers for setting up and retrofitting the throwing frames at the throwing area. For different disciplines special casting rods are necessary. The equipment is retrofitted directly on the sports field. The athlete shifts locally from a wheelchair into the throwing frame. Some athletes need staff support. During this time the standard wheelchair stays nearby. Appropriate weather protection must be available.

#### **8.5. Specific criteria for planning**

##### **8.5.1. Exterior accessibility**

Athletics facilities usually have a large commuter belt, which means that a particular athlete is often made to undertake long journeys. Also due to the necessity of transportation of sports equipment the use of personal cars is very important. Accordingly, a sufficient number of suitable parking spaces must be provided. In this regard, the interconnectivity between the parking space and the sports field plays an important role. It should be at the ground level, without thresholds and short. Attention must be paid to wheelchair-compatible layer, proper illu-



mination and equipping with guidance and guiding systems. Gates and gateways should be designed which are wide enough to allow racing wheelchairs.

### 8.5.2. Entrance area and interior accessibility

Assuming a DIN-compliant construction, there would be few additional requirements for the interior accessibility of athletic facilities. Outside the actual competition area normally no sports wheelchairs are used, which means that the premises must be designed only for use with standard wheelchairs.

The tracks of an athletics field can be used by blind and visually impaired athletes with sports wheelchairs mostly without any problem. The inner boundary of the tracks contradicts the full usability of the system by wheelchair athletes. According to IAAF the track must be surrounded on the inside by a 5 - 6.5 cm high and 5 to 25 cm wide kerb. However, this can be removed temporarily to allow access to the technical disciplines. Especially in the area of the running track to the water ditch and the run-up section for the javelin throw possibilities for corresponding modifications are planned.

The areas for the field events are generally accessible if they are located outside the lawns, as required by IAAF. The integration of the throwing areas in lawns should be avoided if possible, since this is difficult to navigate with wheelchairs.

### 8.5.3. Changing and sanitary areas

For the changing rooms and the sanitary areas, the basic requirements are applicable, such as those defined in section 4.4. Basically, it is important that the changing rooms and sanitary facilities meet the needs of individual athletes as well as those of groups, such as for physical education. The number of changing rooms is based on the development plan. Changing rooms with

separate dressing rooms are limited due to the limited manoeuvring space only suitable for use by athletes with disabilities. The cabinets must be large enough to accommodate prostheses.

The sanitary facilities should be reachable from the sports field on a short path; otherwise, separate toilet facilities should be provided at the sports field.

### 8.5.4. Sports installations: Sports fields and stadia

Based on the *IAAF Competition Rules* and the *IAAF Track and Field Facilities Manual*, the IPC formulates together with the IPC Athletics Official Rules and Regulations for IPC Athletic Competitions different or additional requirements for Paralympic sports. These are mainly related to functional procedures of the competition and to regulating the permitted accessories and sports equipment used. Thus, also in Paralympic sports a standard competition facility is used according to IAAF. The tracks for steeplechase, pole vault and hammer throw are not used because these disciplines are not practised. Additional constructional requirements are formulated in comparison to IAAF by the IPC exclusively for the construction of long jump facility and the design of circular frame.

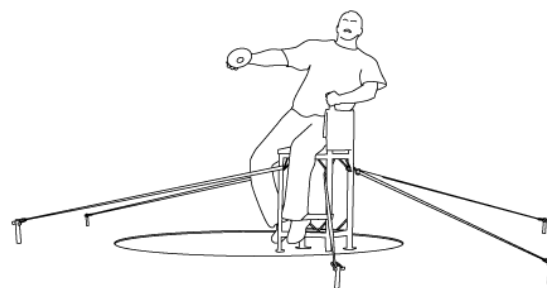
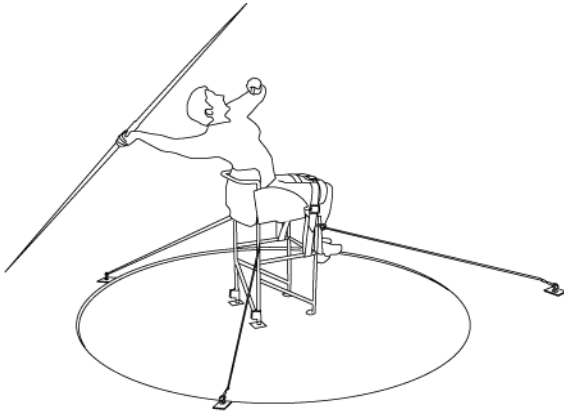
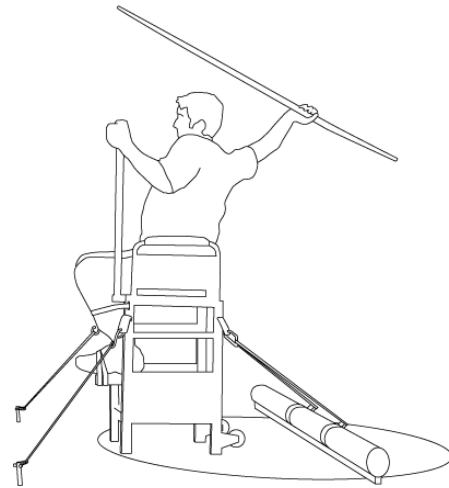


Fig. 57: Fixing a throwing frame by eyelets into the ground around the circular frame



*Fig. 58: Fixing a throwing frame by sleeves integrated with the circular frame and additional sleeves in the throwing sector*

The throwing systems must be adapted to the needs of the wheelchair athletes by anchoring the throwing frames into the circular frame. For this, there are different variants in which the throwing frame must always be firmly clamped to the throwing circle using straps, ropes, chains or bars. It is advantageous if the orientation of the frame is flexible and adjustable within the throwing circle according to the needs of the thrower and not fixed rigidly. The images show examples of three versions.



*Fig. 59: Fixing a throwing frame by an anchoring beam over the circular frame and additional eyelets in the throwing sector*

The common long jump systems can be used by many blind and visually impaired athletes but only with modifications. In many cases, the jump is coordinated acoustically through shouts by the coach or a guide. A precise jumping from a standard jump board with a depth of 20 cm without passing over it or losing width is very difficult. The IPC therefore calls for a jump zone of 1.00 m length and 1.22 m width (corresponding to the width of the runway). Since the jump is measured from the actual spot from where the athlete jumps, the drop zone should be designed to enable the athlete leave a corresponding impression. In addition, the landing area must have a width of at least 3.50 m. The varying requirements of IAAF and IPC are summarized in Table 3.

### **8.5.5. Athletics halls**

Compared to sports grounds and stadia, athletics halls are different mainly in size and in available weather protection. The advantages are that these can be used throughout the year and the conditions for training remain uniform.

Table 3: Differences in the requirements of IAAF and IPC for a long jump field

Criteria for construction	Requirement by the IAAF <sup>1</sup>	Deviating requirement by the IPC (start class)
Width / Length of runway	w=1.22 m; l min. 40.00 m	-
Jump	Jump board with w=20 cm	Jump zone with w=1.00 m (start classes F11-12)
Jump- Beginning of landing pit	Long jump: 1.00 – 3.00 m  Triple jump, international: min. 13.00 m (men) and min. 11.00 m (women)	-  Triple jump: 11.00 m (men start class F46) 9.00 m (women start class F46) min. 9.00 m (start class F11) min. 11.00 m (start class. F12-13)
Width of landing pit	min. 2.75 m	min. 3.50 m
Jump – End of landing pit	min. 10.00 m	-

According to the equipment and usability the following hall types are differentiated as defined by BISp:

- Event hall: Hall with circular track and other athletic facilities, with spectator facilities
- Competition hall: Hall with circular track and other athletic facilities, without spectator facilities
- Training hall: Indoor track and field facilities, without running track and without spectator facilities
- Practice arena: Standard Sports Hall according to DIN 18032, with additional facilities for easy athletic training.

However, due to the limited space available in the hall not all disciplines can be practised. These are usually the throwing events. Buildings with throwing facilities can also be used for casting the throwing devices from inside into a throwing sector outside the building. Another method is to practise throws into a net for improving the throwing technique.

According to the requirements of the IAAF, athletics facilities should be completely enclosed and have as a rule a 200-m an oval running track. Depending on the seating facilities, there are also running tracks less than 200 meters; these are not suitable for international events. Also the gradient of a 200-m track is suitable for speed wheelchair users only to a limited extent. The track can be used only for training purposes, but not for competitions in this discipline.

The requirements for the athletics hall for use by athletes with disabilities are not different from those which are imposed on stadia and sports fields. The important point is the accessibility and usability of the hall for speed wheelchair users, despite the limitations due to the short distance.

#### 8.5.6. Other service facilities and rooms

In athletics sports facilities storage systems for sports equipment are necessary. For this, according to DIN 18035-1 the specified guide value for storage space is 0.15 m<sup>2</sup> for every 100 m<sup>2</sup> outdoor sports area. The size

of the required storage space varies significantly with the use of the facility. In sports for people with disabilities, additional storage space is required to accommodate throwing frames, racing wheelchairs or other specific sports equipment.

Especially in the competitive sports sector, power play rooms, relaxation rooms and areas for physiotherapy play an important role. The requirements according to DIN for barrier-free construction should also be implemented here.

### **8.5.7. Service facilities for competitions and spectator areas**

The functional procedures during a competition differ substantially from those during training. In competitions, the athletes must warm up themselves outside the actual competition facility, because access to it is only permitted just before the actual competition. For these purpose, a separate warm-up area is required. This is usually a track and training facilities for the throwing events. For smaller events a park or a play field adjacent to the competition venue is used.

The athletes use the warm-up area after changing, before their actual competition. A direct pathway to the changing area is therefore useful. Likewise, a short path between warm-up area and parking is recommended, because the racing wheelchairs and other sports equipment need to be carried in this way to the preparation site, and later to the competition.

From the warm-up area the athletes go into the so-called *Call Room* or *Call Area* about 30 minutes before the competition. This room or area is the waiting place for athletes prior to their call for competition and for checks at athletic competitions. Different administrative tasks are carried out here. This includes the registration of the presence of the athletes, issue of starting numbers, and, if necessary, testing the sports equipment. The dimensions of this area depend

on the expected number of athletes and thus vary largely with the type of competition. The IAKS specifies a guide value of 2m<sup>2</sup> per athlete. The IPC calls for the storage and control of racing wheelchairs in this area. The usability of this space or area with the racing wheelchair must therefore be ensured. The distance to the warm-up area and to the competition area must be short.

Entry into the actual competition venue is through the *Call Area* and is strictly supervised. The athlete and possibly the guide may only enter this after their call for competition. For coaches and other accompanying persons, access is denied.

Leaving the competition area is not through the *Call Room*. If necessary, the athletes must go for doping checks accompanied by officials directly after the competition.

Wearing prosthesis, especially in the case of above-knee prostheses can be very debilitating for the athlete. Looking at the long waiting times at competitions of athletes up to their passage at some events, it is evident that seating facilities nearby are necessary for them to relax during all disciplines. Athletes can change here into their sports or standard prostheses or, as the case may be, into other sports prostheses.

At competitions toilets must be directly accessible to the athletes from the warm-up area, from the *Call Room* and from the competition area. There is one restriction for athletes in racing wheelchairs; visiting the toilet is not possible in it.

Facilities for doping checks must also be implemented barrier-free. Even athletes in racing wheelchairs come directly from competition for doping check. Accordingly, before the doping check enough space for changing from the sports wheelchair into standard wheelchair and possibly a storage space for the wheelchairs must be provided.

Especially for events held on several days, maintenance of a central storage facility is

necessary for racing wheelchairs. This should be reachable quickly and conveniently even on wheelchairs from the warm-up area and from the parking area. Combining the wheelchair station with a covered workshop area for reconstruction work on sports wheelchairs is recommendable.

For the spectator facilities in athletics stadia and halls, basically, the requirements for barrier-free construction are applicable. A point to be noted is that the spectator facilities are used often by the athletes themselves to watch the ongoing action during the competition breaks. Therefore, spectator facilities must also be accessible equally from the sports field for all disability groups. This also applies to temporary facilities, such as the additional wheelchair-compatible toilets, fencing systems for separating the competition area, benches for athletes with sun shield on the field or on the track or other wheelchair accessible parking spaces.



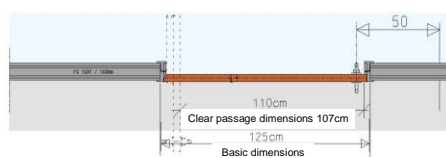
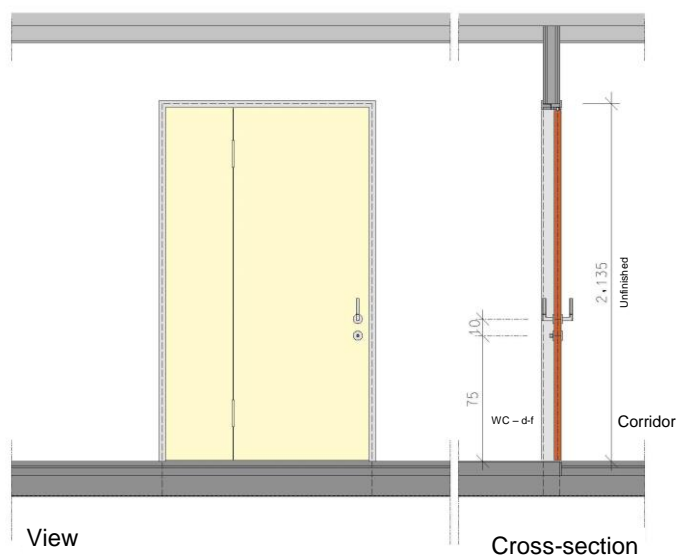


Fig. 61: Example: Space-saving door (shell dimensions 1.26 m) (Dipl.-Ing. M. Bruckner).

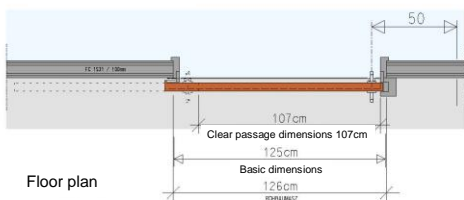
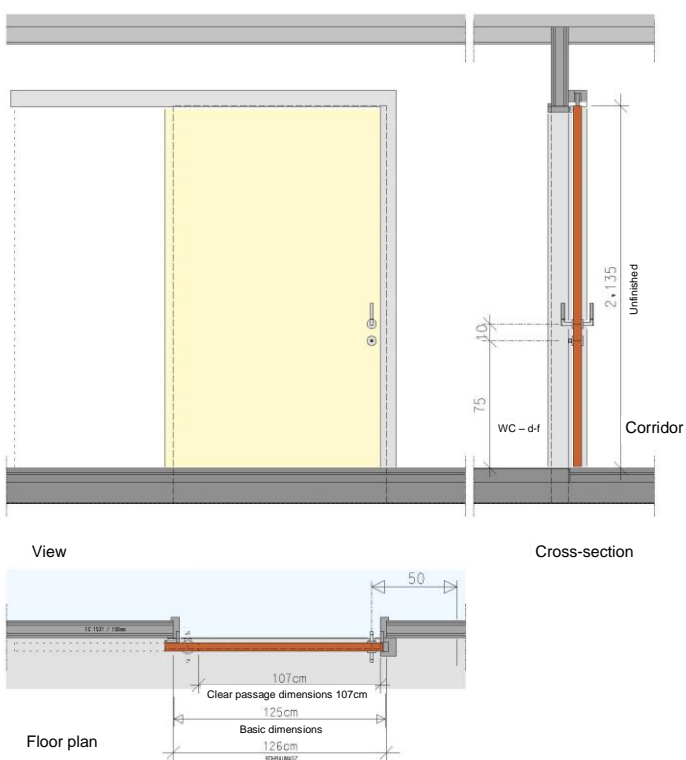


Fig. 62: Example: Sliding door (shell dimensions 1.26 m) (Dipl.-Ing. M. Bruckner).

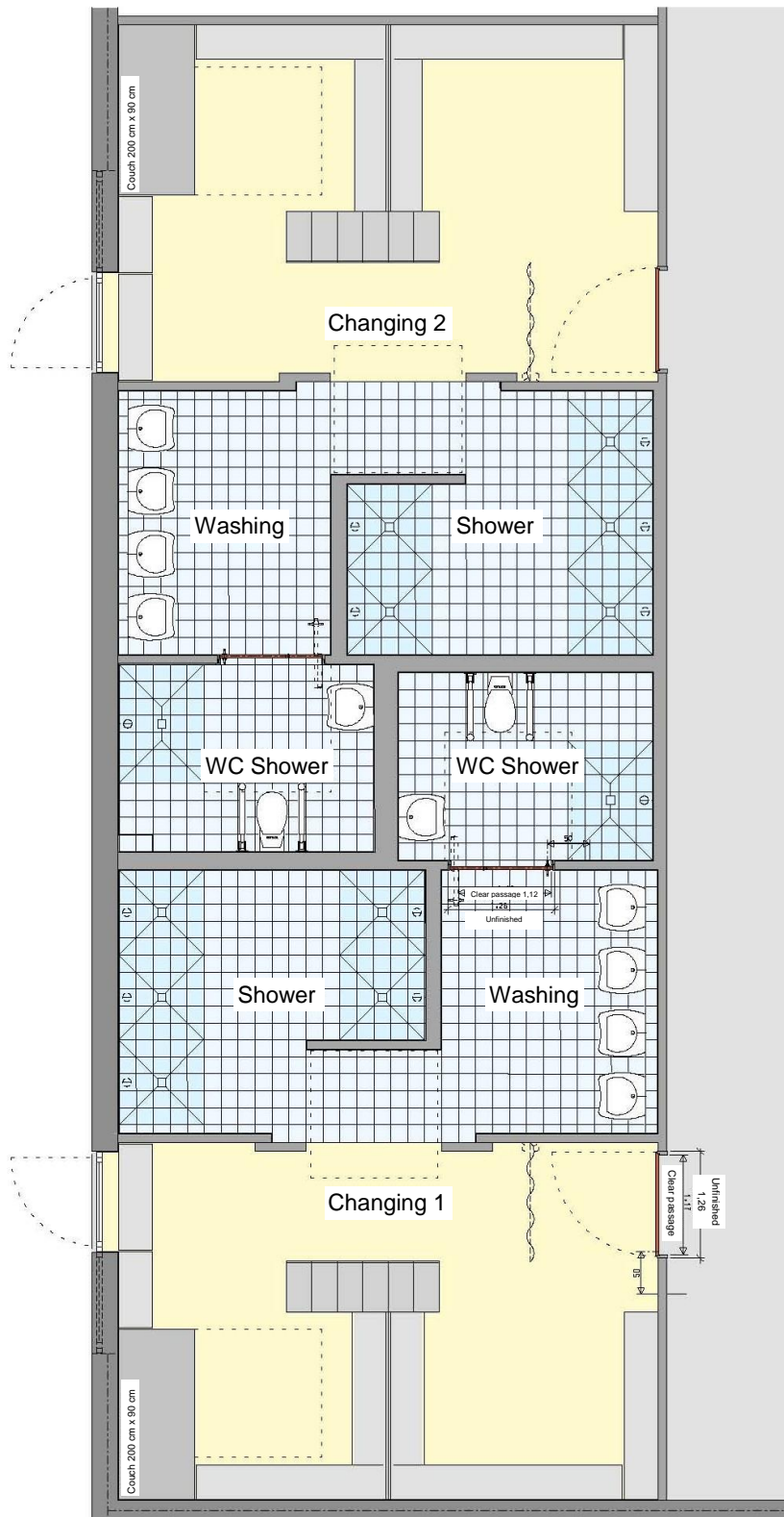


Fig. 63 Example: Single sports hall according to DIN 18032-1 and DIN 18040-1 with two units for changing and sanitary enclosure (Dipl.-Ing. M. Bruckner).



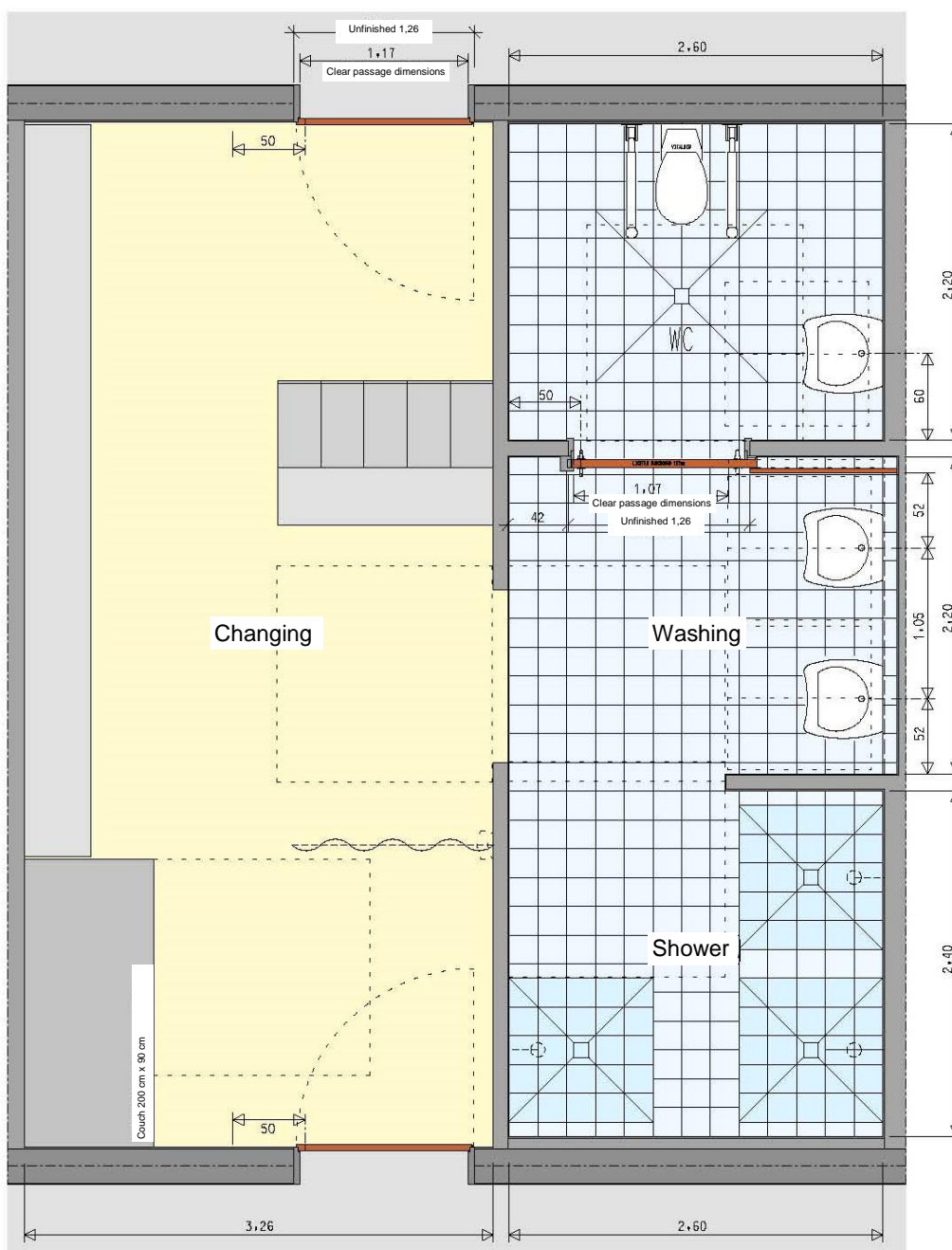


Fig. 64 Example: Double / triple sports hall according to DIN 18032-1 and DIN 18040-1 with half unit for changing and sanitary enclosure (Dipl.-Ing. M. Bruckner).

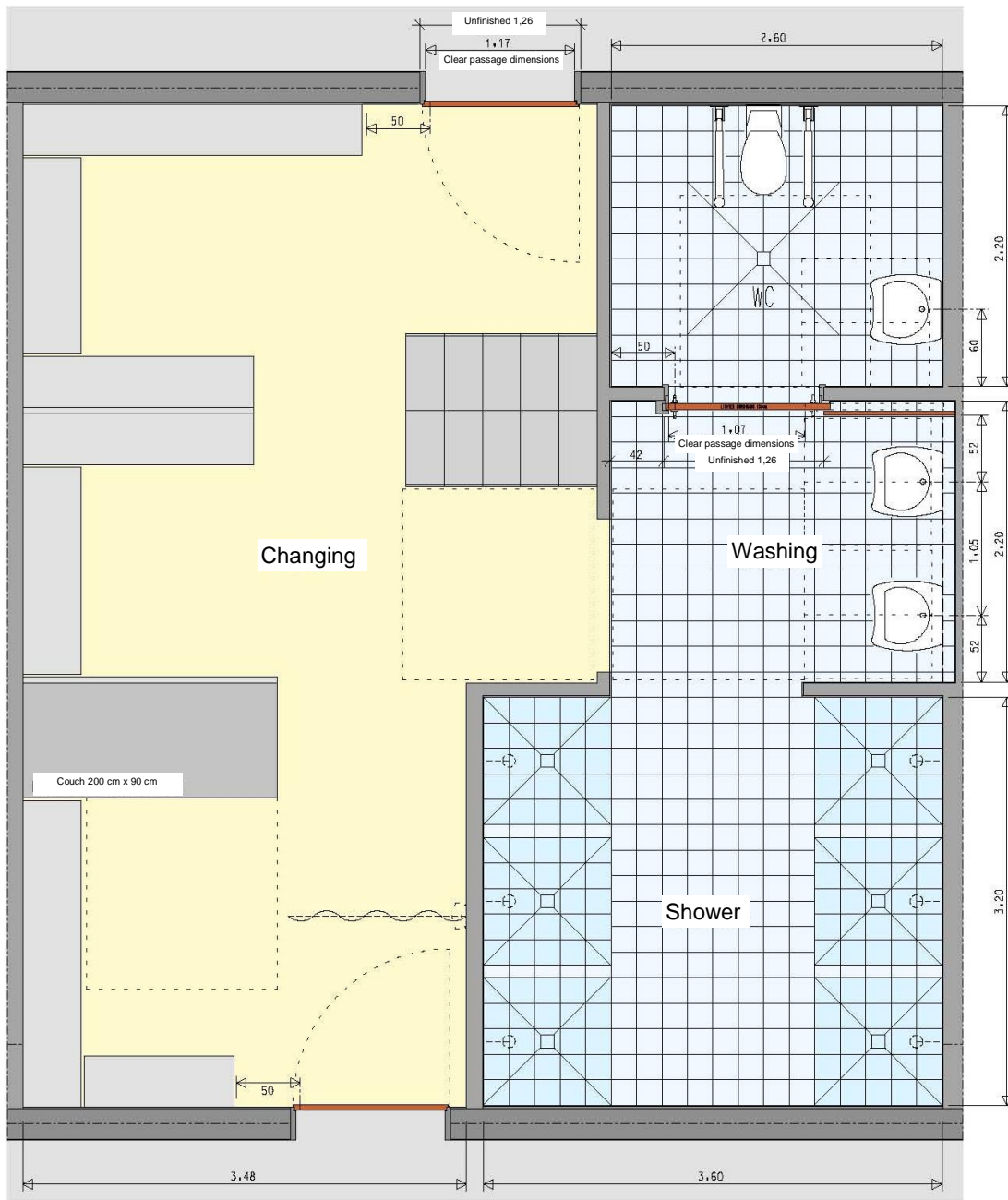


Fig. 65 Example: Double / triple sports hall according to DIN 18032-1 and DIN 18040-1 with a unit for changing and sanitary enclosure (Dipl.-Ing. M. Bruckner).

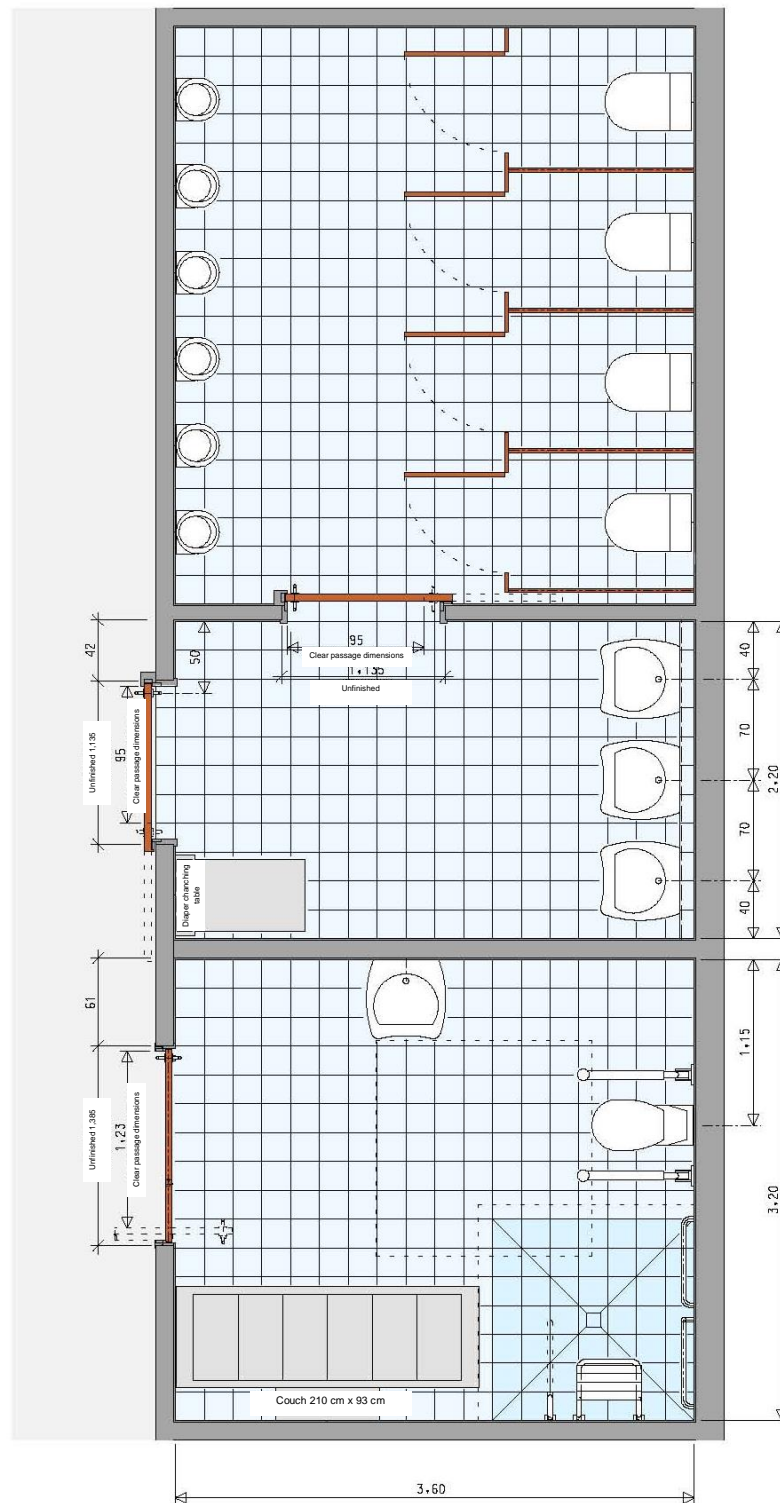


Fig. 66 Example: General toilet facility of a double / triple sport hall or a stadium according to DIN 18040-1 (Dipl.-Ing. M. Bruckner).

## Concluding remarks

The principles of planning are consistent with the currently existing requirements based on the limitations of the users, the classification, the use of sports equipment and the applicable regulations. In future, as new sports are developed, sports devices undergo technical improvements and the functional procedures are modified and the regulations for the existing types of sports are changed, there may be new requirements for the construction of sports facilities. But it is safe to assume that they can be adapted more easily if the sports venue, in conformity with the principles of a *universal design*, enables mostly everyone to use it just normally, without any difficulty and basically without the need for assistance.

The implementation of the basic principles identified in this research project is not confined to the training and competition venues of the competitive sport alone. Sports facilities must be fundamentally barrier-free and allow self-determined use; fulfilling these conditions will be conducive to the cultivation of recreational, educational and rehabilitation sports - which is the starting point for the achievement of excellence in performance. Creation of barrier-free access is, therefore, a primary objective of planning which must be pursued right from the start of a design.

We help sports...

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