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Planning, constructing and maintaining sustainable and safe outdoor sports facilities



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1 Planning, constructing and maintaining sustainable and safe outdoor sports facilities¹

1.1 Planning and constructing sustainable outdoor sports facilities

“Sports grounds are an important part of the urban and regional infrastructure of the federal states (Länder) and municipalities” (DIN 18035- 1:2018-09). They serve sport, leisure and recreation, thus meeting people’s social and cultural needs.

Outdoor sports facilities generally have a high level of land consumption. However, the publication *11 Thesen zur Weiterentwicklung von Sportanlagen* (Eleven theses on the further development of sports facilities, Federal Institute of Sport Science, 2018), confirms that “the need for decentral sports facilities in quarters/city districts near people’s homes“ is increasing. Easy accessibility is important for children, young people and older people. Yet Meinen et al. (2016) state that the market value of properties near outdoor sports facilities is lower, for example due to noise disturbance. The conflict between the need for outdoor sports facilities near people’s homes and noise emissions in the neighbourhood should be weighed up in each individual case with the participation of the people concerned, such as athletes, local residents and operators.

An Assessment System for Sustainable Outdoor Sports Facilities can help in this process and with other planning issues. This system recommends actions for decision makers in the outdoor sports sector

1 This summary is based on two research projects carried out at the University of Applied Sciences Osnabrück. The project “Sustainability of Outdoor Sports Facilities” received funding from the Future Building (Zukunft Bau) research initiative of the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) (file reference: SWD-10.08.18.7- 14.28). The results relate mainly to the planning and construction of outdoor sports facilities. Source, unless otherwise shown: Katthage/Thieme-Hack 2017. The project “Safety management in outdoor sports facilities” addresses the safety of sports and ancillary areas as well as of sports equipment and other installation elements such as lighting or ball protection fences. The study focuses on the utilisation phase. Source, unless otherwise shown: Katthage/Thieme-Hack 2012.

and is not to be understood as a template. The special features of every individual outdoor sports facility need to be worked out individually and a balance found between different interests. The assessment system thus promotes the approach of thinking through a process before starting it.

On the basis of the criteria and points achieved, a certificate for outdoor sports facilities can be obtained in bronze, silver or gold. It is not necessary to achieve 100 % of all criteria. Rather, a process that balances different criteria has to be carried out. This requires promoting an optimised life cycle right from the planning stage, leading not only to cost savings but also to the protection of natural resources and a reduction in high levels of land consumption. At least 50 % of the total points must be attained to achieve the bronze certificate, at least 65 % for silver and at least 80 % for gold.

1.1.1 The Assessment System for Sustainable Outdoor Sports Facilities

The Assessment System for Sustainable Outdoor Sports Facilities comprises three parts: criteria profiles, the list of assessment criteria for building materials and standard planning. The criteria profiles define the sustainability requirements for outdoor sports facilities in six quality categories (see table 1).

These are as follows:

- › 7 criteria profiles on ecological quality,
- › 4 criteria profiles on economic quality,
- › 7 criteria profiles on socio-functional quality,
- › 6 criteria profiles on technical quality,
- › 7 criteria profiles on process quality and
- › 4 profiles on location quality.

The *ecological quality* criteria relate to the ‘effect on the global and local environment’ and ‘consumption of resources’. Regarding the first criterion, a high proportion of green and vegetation areas and trees is assessed as being good since this has a positive effect on CO₂ sequestration. There is a tree list to select trees suitable for the location. In addition, potential environmental and health risks of the different sports surfaces are assessed. The second criterion focuses on reducing the consumption of soil, water and energy resources.

Table 1: Overview of the criteria of the Assessment System for Sustainable Outdoor Sports Facilities (Katthage/Thieme-Hack, 2017)

	Groups of criteria/criterion	Weighting	Weighting of assessment criteria
Ecology	1.1 Effect on the environment		
	Ecological effect	2	2.22 %
	Risks for the local environment	3	3.33 %
	Vegetation	3	3.33 %
	Biological diversity and crosslinking	1	1.11 %
	1.2 Utilisation of resources		
Economy	Water – needs and drainage	3	3.33 %
	Soil	3	3.33 %
	Lighting	3	3.33 %
	2.1 Life cycle costs		
	Life cycle costs of outdoor sports facilities	3	8.57 %
	Area efficiency – costs per hour of play	2	5.71 %
Social functionality	2.2 Value maintenance and development		
	Financing options in the production and utilisation phase	1	2.86 %
	Further development planning	1	2.86 %
	3.1 Health, comfort and user-friendliness		
	Reference points for further processing	2	4.00 %
	Vandalism prevention	1	2.00 %
	Safety	1	2.00 %
	3.2 Functionality		
	Convertibility and reutilisation capacity	2	4.00 %
	Public accessibility	2	4.00 %
	Accessibility and orientation	1	2.00 %
	Convenience for cyclists	1	2.00 %
Technology	4.1 Building materials and methods		
	Sustainable building materials and methods	3	3.28 %
	Waste – end of life: dismantling, separation and utilisation	2	2.19 %
	Waste – utilisation and disposal in the utilisation phase	2	2.19 %
	4.2 Technical design		
	Care and maintenance	3	3.28 %
Process	Energy consumption for maintenance	3	3.28 %
	Sport functionality and utilisation	3	3.28 %
	5.1 Quality of planning		
	Inventory and project preparation	2	2.33 %
	Integrative planning	2	2.33 %
	Variant comparisons in object planning	2	2.33 %
	Tender and commissioning	2	2.33 %
	5.2 Quality of construction		
	Construction site	2	2.33 %
	Quality control during the construction process	2	2.33 %
Location	5.3 Management quality		
	Management quality of outdoor sports facilities	3	3.50 %
	6.1 Accessibility		
	Pedestrians and cyclists	2	1.67 %
	Public transport and motorised individual transport	2	1.67 %
	6.2 Influence on the surrounding area		
Emissions from the outdoor sports facility	1	0.83 %	
Integration into the surrounding area	1	0.83 %	

Economic quality comprises firstly a calculation of the life cycle costs of outdoor sports facilities. Secondly, the costs per hour of play are calculated to calculate area efficiency. These criteria are important economic aspects which are also helpful when selecting a 'sustainable sports surface'. In maintaining and increasing value, financing options are considered during the production and utilisation phase and a value development plan is promoted.

Socio-cultural and functional quality has two focal areas:

- 1) Health, comfort and user-friendliness and
- 2) Functionality.

The quality of stay in the ancillary areas relates both to recreational, leisure and additional sports opportunities and to the availability of storage facilities for sports and maintenance equipment. Vandalism prevention and security may have an adverse impact on public accessibility. Individual solutions are required here. Convertibility and reutilisation capacity consider options for using the sports area for disciplines other than the main sport. As well structural accessibility, a concept for sport for people with disabilities is also required. Convenience for cyclists relates to the location and number of bicycle stands.

Technical quality examines both the requirements of sustainable building materials and methods and sustainable technical implementation. It is defined as being the use of materials and components with low consumption of resources and a high recycling rate for building materials. A high proportion of recycled construction materials is also to be promoted and waste disposal is to be taken into account, both at the time of use and at the time of dismantling. Also, the accessibility of components and technical installations requiring maintenance and the energy consumption of machines and equipment are to be taken into account. Sporting functionality and utilisation are a particularly important criterion. Here, the required lifetime is to be linked with the expected use intensity and the planned main sport.

Process quality relates to the planning, construction and maintenance processes over the life cycle. At the beginning, an inventory and project preparation are to be carried out in order to compare different variants in planning the facility within a holistic planning

process. That is followed by integrating sustainability aspects in the tender and commissioning phase and in the construction process. In order to ensure process quality, quality controls are to be carried out during the construction process, and management quality should already be defined at the planning stage by means of maintenance instruction manuals and/or maintenance plans.

Finally, *location quality* defines the accessibility of the outdoor sports facility for visitors coming on foot, by bicycle, by public transport or using motorised individual transport. The influences on the surrounding area are also to be taken into account, for example noise emissions and integration with other sport and leisure facilities and with green and leisure areas.

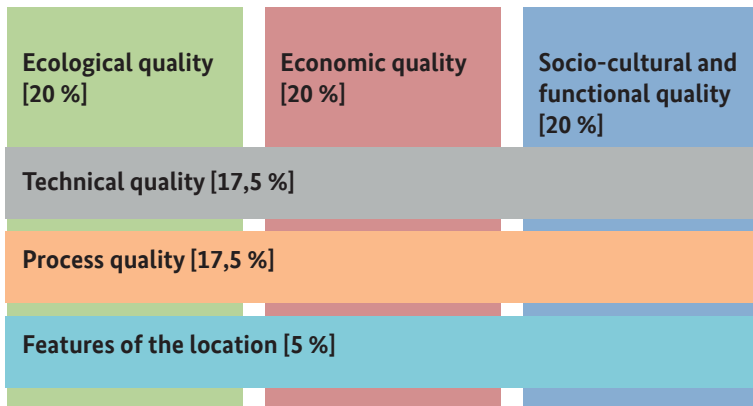


Diagram 1: Quality of sustainable outdoor sports facilities (source: Katthage/Thieme-Hack)

1.1.2 Quality weighting in the assessment system

According to the German Council for Sustainable Development, “environmental aspects are to be treated on an equal footing with social and economic aspects”. On this basis, the three dimensions of sustainability – economic, ecological and social-functional – are assessed equally at 20 % each.

The cross-cutting functions technology and process quality count for 17.5 % each, as they are decisive for the long-term utilisation and

durability of the outdoor sports facility. Location quality counts for 5 % in the calculation.

The individual criteria profiles are weighted using a so-called significance factor of between 1 and 3, comparable with a utility matrix. This is required in order to reduce divergences in the assessment. For example, integration into the surrounding area has a weighting of 1. In contrast, the criteria of utilisation of resources, such as soil, water and energy to increase resource protection, have a weighting of 3.

1.1.3 Construction materials assessment catalogue

The construction materials assessment catalogue and standard planning provide assistance in applying the criteria profiles. The construction materials assessment catalogue is not a construction material reference work but a planning tool for selecting a sustainable sports surface for a particular construction project. The research project defines 29 indicators, assessed by way of example by a group of operators, planners and federal sports federations.

The significance of an indicator can be weighted with a value of between 1 (= low significance) and 3 (= high significance). The respondents considered service life (2.9), life cycle costs (2.8) and suitability (2.7) to be particularly important indicators. The lowest weighting was given to susceptibility to vandalism (1.4), prestige/visibility (1.7) and player fatigue (1.7).

A survey (cf. Kleine-Bösing, 2016) assessed the indicators relating to the surfaces of an outdoor sports facility: natural turf, tamped area, synthetic turf (filling: granule-sand mixture, sand, unfilled, cork and other materials) and hybrid turf on a scale of 1 to 5, where 1 = very good/positive) and 5 = very bad/negative). Table 2 shows that respondents generally assess synthetic turf to be the most sustainable sports surface. The selection of the surface depends on a number of factors. At least the following should be inspected (cf. FLL, 2014, p. 19 et seqq.):

- › Use in terms of:
 - type of use,
 - planned service life
 - use intensity

- › Function in terms of:
 - sporting function;
 - protective function
 - technical function.
- › Cost of:
 - production
 - maintenance and
 - resurfacing.

Table 2: Result of the survey with indicator-weighted and equally-weighted assessment total (Kleine-Bösing/Katthage/Thieme-Hack, 2016)

	Weighting	Proportion Indicator weighting	Proportion equal weighting	Sports turf	Hybrid turf	Synthetic turf with sand filling	Synthetic turf with granulate-sand filling	Synthetic turf without filling	Synthetic turf with other filling	lamped area
Ecological quality	2.30	0.26	0.25	2.30	3.00	2.50	2.90	2.60	2.80	2.60
Economic quality	2.40	0.27	0.25	2.30	2.60	2.50	2.70	2.60	2.80	2.20
Sociocultural/functional quality	2.00	0.22	0.25	1.50	1.60	2.30	1.70	2.20	1.90	3.90
Technical quality	2.30	0.26	0.25	1.97	2.07	2.13	2.07	2.07	2.10	2.97
Indicator-weighted assessment total				2.04	2.34	2.36	2.37	2.37	2.42	2.88
Rating				1	2	3	4	5	6	7
Equal-weighted assessment total				2.02	2.32	2.36	2.34	2.37	2.40	2.92
Rating				1	2	4	3	5	6	7

1.1.4 Standard planning

Standard planning supports various planning situations at three levels of detail:

- › overview function plan,
- › standard plan for a large playing field and
- › cross-sections.

The overview function plan takes up various requirements of the criteria profiles and presents them visually, making it easier for decision makers to weigh them up.

Building on the overview function plan, a plan for the standard planning of a large playing field is provided. This plan shows proposed solutions for the following areas: mobile football goalposts; distance from shrubs to sports area and adjoining paths. The position of cross-sections is also indicated. The cross-sections include in particular proposals for action concerning the width of paths and the positions and edging around ball protection fences and barriers.

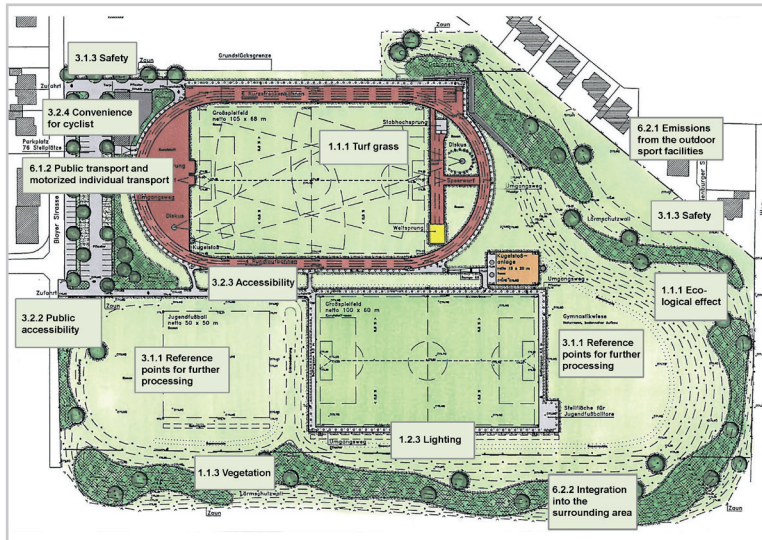


Diagram 2: Overview function plan 2 (source: Illgas in Katthage/Thieme-Hack, 2017)

1.1.5 Applying plans to practice

The assessment system offers the possibility to optimise outdoor sports facilities for the benefit of users, the surrounding area, the environment and the financial situation. The obligation of actors to weigh up contradictory options against one another and to communicate the decision-making process promotes the sustainability of outdoor sports facilities. The Assessment System for Sustainable Outdoor Sports Facilities is not a template! The coordination and

weighing-up process leads to an individually optimised solution. It is important to include all concerned in this process to ensure that there is a common, generally-accepted understanding about decisions.

The Assessment System for Sustainable Sports Facilities takes up various issues relating to outdoor sports facilities. As well as classic subjects such as sports functionality, cost and the construction of new buildings, this also takes innovative approaches into account.

These include:

- › ascertaining risks for the local environment, e.g. resulting from sports surfaces,
- › introducing a so-called tree-free zone to protect sports function and use without sacrificing the positive ecological effect of trees,
- › requiring a lighting concept with movement and presence detection lighting along paths, and taking into account enhanced lighting levels and glare from training lighting,
- › calculating the life cycle costs and costs per hour of play,
- › defining the required service life, utilisation intensity and main sport to select the optimal sports surface,
- › planning areas for changed user requirements and trend and health sports,
- › developing a concept for public accessibility for individual athletes, taking into account use by clubs and schools as well as safety and the prevention of vandalism,
- › presenting a maintenance handbook in line with an individual maintenance and development concept,
- › describing different situations which may occur on the edge of playing fields with a view to show a barrier-free route design.

1.2 Safety management in the context of maintenance to ensure safe outdoor sports facilities

The following measures relate to construction aspects. In addition, other points are to be observed in the context of comprehensive safety management. These include planning recommendations to enhance individuals' subjective and objective perceptions of safety and simulations of stadium evacuation concepts.

The Landscape Development and Landscaping Research Society (Forschungsgesellschaft Landschaftsentwicklung, Landschaftsbau, FLL) defines "maintenance guidelines" in line with DIN 31051 as measures to protect and preserve sports areas and the corresponding technical facilities or to restore them to the required functional status/functionality and to ascertain and evaluate their current condition" (FLL, 2014, p. 16).

According to this definition, maintaining outdoor sports facilities comprises inspection, repairs, maintenance, improvement and upkeep. Inspection comprises "measures to determine and evaluate the present condition of the sports areas and the corresponding technical facilities" (FLL, 2014, p. 16).

The term "safety management" is understood to mean the sum of all measures taken and efforts made to protect users against dangers. This means that safety management for outdoor sports facilities should comprise at least an inspection and documentation.

Rotermund and Krafft (2013) add the following: "Of course, all these facilities [i.e. sport and leisure facilities] are subject to the operator's public safety obligation, comprising in particular compliance with the respective DIN standards, accident prevention provisions etc. and the required public safety controls" (Rotermund/Krafft, 2013).

The FLL (2014) states that "anyone - proprietors, owners or organisers - who puts a sports facility "into circulation" [...] is responsible for its orderly condition and thus for public safety measures." This means that such people are required "to protect users as far as necessary and reasonable from any discernible specific risks that this facility could pose" (cf. FLL, 2014, p. 32).

Other regulations arise under provisions including the following:

- › DIN 18035, parts 1 to 7,
- › European playing field equipment standards (e.g. DIN EN 748 “Playing field equipment - Football goals - Functional and safety requirements, test methods“),
- › Guidelines such as the FLL guidelines for the maintenance and use of outdoor sports facilities (2014) and
- › German Social Accident Insurance (Deutsche Gesetzliche Unfallversicherung, DGUV) Regulation 1, “Accident prevention regulation - Principles of prevention“ and DGUV Information 202-044 “Sportstätten und Sportgeräte“ (Sports facilities and sports equipment).

DGUV Information 202-044 explains that sports facilities and sports equipment are to be inspected, at least for any externally visible damage or defects, before commissioning, at regular intervals and after any alterations to ensure they are in safe condition.

1.2.1 Organising inspection and documentation

“We understand liability to mean taking responsibility for our own behaviour or the behaviour of others. Liability is possible through taking action or through refraining from taking action“ (Rampke, 2011). Operators of outdoor sports facilities, often represented by the club’s executive board, the mayor or the managing director, generally have overall responsibility for a facility’s public safety.

Sports facility statistics of the Länder state that a few years ago, the question of who operated sports facilities was of little interest

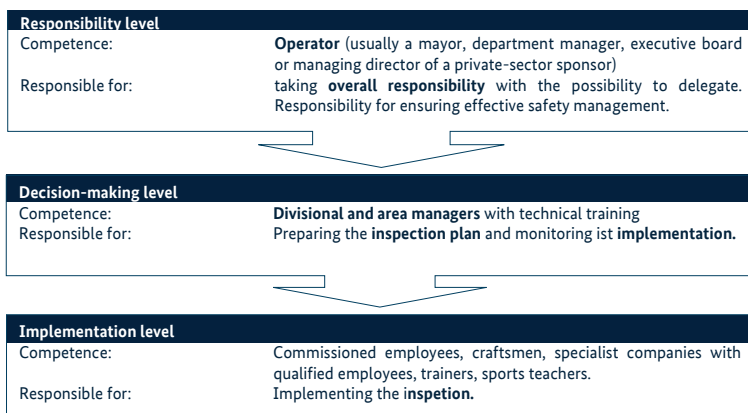
“since municipalities generally funded [...] the sports facility infrastructure near people’s homes. However, the world of sport is changing [...]. As well as the growing popularity of new types of sport, private operators have gained importance in the operation of sports facilities. Clubs and federations take the burden of operating them away from municipalities that are frequently overburdened.“

(Sports Facility Statistics for 2002, p. 21).

However, municipalities usually assume the role of operator and the clubs act “as an important ‘second force’” (Sports Facility Statistics of the Länder, 2002, p. 26).

If in the case of an accident a breach of the obligation to ensure public safety is identified, the party responsible may be held liable. Thus, the parties responsible should make use of the possibility of delegation. Instructions may be given to departmental and area managers, for example, enabling them to draw up an inspection plan in their function as decision makers and to monitor implementation of the inspection. Implementation of the inspection may be delegated to authorised employees, craftsmen, specialist companies, trainers or sports teachers. In this connection, it is also important that information about any defects found in an outdoor sports facility at implementation level are passed on first of all to the decision-making level so that it has the opportunity to take measures to once again fulfil its public safety obligations. Also, the decision-making level should inform the responsibility level, so that this level can take overall responsibility (cf. table 3). The responsibility level should ensure that an effective safety management system is in place, consisting of delegation and feedback as well as inspection and documentation, guaranteeing the highest possible level of safety for users (cf. FLL, 2014 et al.).

Table 3: Organisation plan safety management (in line with FLL, 2014)



1.2.2 *Types of inspection and responsibilities*

In principle, three types of inspection can be distinguished. These are as follows:

- 1) Visual and functional testing,
- 2) Annual main inspection and
- 3) Stability tests of sports equipment and engineering structures

1.2.2.1 *Visual and functional testing*

Visual and functional testing serve to recognise defects that may be the result of use, wear and tear, weather conditions, vandalism or other influences on an outdoor sports facility. A visual test is generally to be carried out once a week by a person on site. Special circumstances, such as repeated vandalism or a high level of use, may make daily inspections necessary. Visual inspection takes place by means of an on-site visit to check the sports areas, sports equipment and ancillary areas for any possible visible defects.

The functional test is an operative inspection to check the functioning of the outdoor sports facility. The test should be carried out every one to three months by on-site personnel. These may be groundsmen and groundswomen, sports teachers or trainers. It is recommended that testers have received training or instruction on typical damage and defects of outdoor sports facilities.

1.2.2.2 *Annual main inspection*

The annual main inspection should be carried out once a year as an external inspection by a trained person. Carrying out an external inspection has two advantages. Firstly, experienced sports ground testers familiar with the required standards and guidelines for sports fields should be commissioned. Such people have extensive specialist knowledge. Secondly, the examination is carried out by someone other than those who are regularly at the outdoor sports facility. This enables the dual control principle to be applied.

The annual main inspection is to be carried out as an extensive visual and operative inspection using simple testing tools, for example dummies for testing places where fingers or heads could be-

come entrapped. The whole of the outdoor sports facility is inspected. A distinction can be made here between the sports areas, sports equipment, ancillary areas and engineering structures (cf. table 4).

Table 4: Types of inspection and responsibilities (in accordance with FLL, 2014)

	On-site personnel	External monitoring
Visual inspection	Daily to weekly	
Functionality test	Monthly to quarterly	
Annual main test		Annually
Sports equipment inspection		Every three years
Civil engineering structures		Every six years

1.2.2.3 *Stability tests of sports equipment and engineering structures*

The specialist standards for sports equipment describe safety requirements regarding the stability and structural strength of sports equipment. Compliance with these testing requirements is to be examined at least once every three years.

Let us take the example of football goalposts. In accordance with DIN EN 748:2018-04, goalposts must fulfil a stability test with a vertical pull of 1,100 N and a strength test with a horizontal pull of 1,800 N. The stability of engineering structures such as training lighting and floodlight masts or ball protection fences should be tested every six years. Various specialist companies offer different testing methods in this area.

It is absolutely essential to document all inspections. That is the only way for operators to have evidence that the inspection has been carried out and concerning the measures and urgency of defects. The extent of the documentation varies. Particularly in the case of visual and functional testing, simple digital or paper checklists may be sufficient.

In the case of main annual inspections, the reports are generally more comprehensive. They should provide information indicating the seriousness and urgency of the defects. Photographs are also recommended to make reports easier to understand. As a minimum, reports should also contain the following information:

- › Name of outdoor sports facility,
- › Type of inspection,
- › Date of inspection,
- › Defects identified,
- › Information on required additional tests and testers (cf. FLL 2014, p. 36).

Stability tests generally result in numerical values. These values are to be included in the report and, if necessary, interpreted in order to make them easier for the operator to understand.

Selection of typical damage and defects in outdoor sports facilities

The following photographs illustrate selected situations involving damage and defects in outdoor sports facilities.

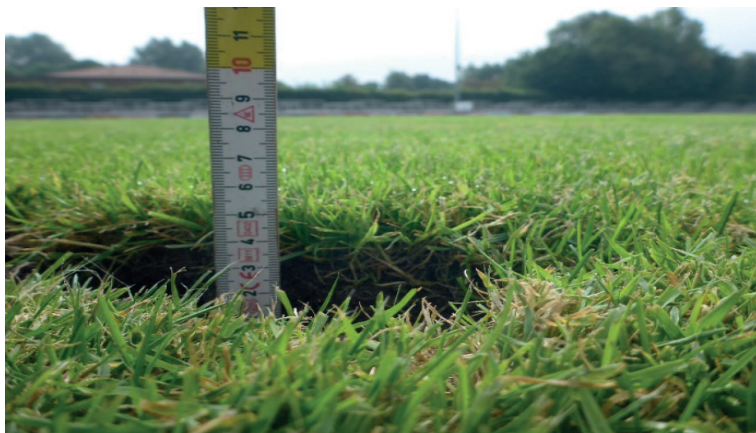
Sports surfaces



Open seams in synthetic grass surface. The surface is also very worn.



Worn-out surface in the goal area



Holes in synthetic turf surface



Molehills



*Minimum safety distance and unobstructed distance are not maintained
(cf. DIN 18035, part 1)*



Holes in tamped surface and coarse grain on the covering layer

Sports equipment and other equipment



Rewelded bar that was later removed. Potential risk of injury from sharp edges.



Backstay rewelded with the ground bar which with later use has split next to the welding seam.



DIN EN 748 does not permit open metal hooks.



Unsecured goalposts can be used by anyone at any time. Also, the ground bar is bent.



Risk of injury from open rear ground bar with sharp edges.



Crooked streetball installation. This may reduce stability.



Defective surface and take-off board at the landing pit may cause users to trip and fall.



Defective walls of a shelter generally have sharp edges which can injure users.



Publicly accessible electrical equipment. Interference by children can have serious consequences.

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