The SAPCA Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches

Building for Better Sports and Play

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The Sports and Play Construction Association

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Disclaimer

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Some synthetic turf system products and designs, available to potential clients may be covered by Patents; clients should ensure that the use of similar products does not infringe any patents held by manufacturers or installers. The Sports and Play Construction Association (SAPCA) do not accept any liability for choice of surfacing systems infringing any current or future patents.

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Introduction

The Sports and Play Construction Association (SAPCA) has produced this document to provide prospective clients and specifiers with guidance on the basic construction requirements and specifications currently employed in building a synthetic turf sports pitch.

The document calls on the experience of our member companies who have constructed a wide range of installations for a variety of clients over many years. The requirements of the various sports' governing bodies and the relevant standards organisations are incorporated, where appropriate, in the document.

Whilst it is not intended that this document should become part of a contract, it is hoped that it will prove useful in the selection of an appropriate system and form a useful reference in the design and construction process.

SAPCA recommend that experienced, professional consultants be retained to provide the necessary level of expertise in designing and detailing sports facilities and ensuring compliance with all of the current legislation. In the case of pitches, where the appropriate choice of carpet for the intended usage is vital to the success of any project, independent professional advice is essential.

Notes to be read in conjunction with the Code of Practice

- This Code of Practice is intended for use by sports surfacing contractors; sports facility design professionals and sports pitch purchasers and owners. The Code of Practice should not be used as a substitute for carrying out appropriate surveys and obtaining professional advice in individual circumstances or as a works specification. Although the Code of Practice has been produced by reference to facilities constructed under normal climatic conditions in the United Kingdom, the Sports and Play Construction Association cannot accept any responsibility whatsoever for any loss, damage or injury whatsoever arising from reliance on the specifications within the Code of Practice.

- The Code of Practice provides minimum guideline specifications which members of the Sports and Play Construction Association are committed to meet. As guideline specifications, however, they do not supersede a reasonable interpretation of the specification and terms of contract applying in each contract. For individual projects, variations in climate, soil conditions, topography, planning constraints and other site-specific conditions may necessitate standards of specification greater than those recommended in the Code of Practice.

- Parties not experienced in synthetic sports surfacing construction are strongly advised to consult qualified contractors and pitch construction consultants. The Sports and Play Construction Association can provide details of experienced contractors and consultants.

- Whilst the term 'asphaltic concrete' is the internationally accepted technical name for all surfaces which are composed of a mixture of bitumen and stone, this Code of Practice uses the generic term 'macadam', as this is still the commonly used name for asphalts within the UK.

- In accordance with common practice within the construction industry (used, for example, in BS EN 13108 for Asphaltic Concretes), the depth of any individual construction layer is specified within the Code of Practice as the nominal compacted depth. The nominal depth can be regarded as the design depth of a layer of construction within a sports pitch system.

- The information contained within the Code of Practice, whilst accurate at the time of publication, may be subject to change at a future date. Due to changing technology and new developments in construction methods as well as the changing requirements of the sports' governing bodies and relevant CEN Standards, revisions to the recommendations are likely, and only the most recent edition of the Code of Practice should therefore be used.

- A permanent joint committee will keep under review the use of the Code of Practice and will consider any suggestions for amendment, which should be addressed to the Technical Manager, The Sports and Play Construction Association, Federation House, National Agricultural Centre, Stoneleigh Park, Warwickshire CV8 2RF. Revision to the Code of Practice will be made when it is considered appropriate.

- Due to the fact that many of the processes used in constructing synthetic sports systems are highly susceptible to weather conditions such as temperature, humidity,

rainfall, etc, it is advisable to check with the specialist contractor as to the most suitable time of year for the installation of his proprietary product.

- Many planning authorities now publish very specific local planning requirements in the form of framework documents and development plans; these will include requirements for many types of outdoor sports facilities. The design of most elements of a synthetic turf pitch are likely to come under scrutiny, such as fencing, floodlighting, hard surfaces areas, landscaping, planting and drainage. It is essential that the designer of a facility has the experience and knowledge to undertake a full design at planning stage. They are likely to have to prove that the design meets all the requirements and may have to submit calculations to prove compliance.

- The Construction Design and Management Regulation 2007, require that a CDM coordinator be employed during the design, specification, tendering and construction phases of any construction project that employs over a certain number of personnel or runs for more than a certain length of time. The CDM coordinator's role is that of ensuring all H&S paperwork is in place, that it meets the minimum requirements of the regulations and all paperwork is passed to the client, the designer and the contractor when required. It is the client's duty to ensure that a CDM coordinator is employed for the project and that they have full knowledge of their own responsibilities under the regulations.

Participating Organisations

The Code of Practice for the **Construction and Maintenance of Synthetic Turf Sports Pitches** has been produced in consultation with the following organisations, and is recognised and supported by them as the minimum standard for the construction of synthetic turf sports pitches in the UK.

- Sport England
- Sport Scotland (TBC)
- English Hockey
- Fields in Trust
- Institute of Groundsmanship
- Quarry Products Association

Note:

Users of the Code of Practice are advised to ensure that they are fully aware of any further technical requirements or criteria which may be imposed by a specific funding body for individual facility development projects.

The Sports and Play Construction Association (SAPCA)

As the recognised UK trade association, SAPCA fosters excellence, professionalism and continuous improvement throughout the sports and play construction industry, in order to provide the high quality facilities necessary for the success of British sport.

SAPCA's Aims and Objectives

- To promote high standards of design, construction and workmanship for sports facilities in the UK.
- To regulate the industry through the vetting and monitoring of SAPCA members.
- To participate fully in the development of British, European and other Standards for the construction and performance of sports facilities, for all levels of play.
- To liaise closely with the governing bodies of sport, both nationally and internationally.
- To encourage the use of new technology in the design and construction of sports facilities.
- To provide and support training and education for the industry's workforce.
- To provide a strong voice for the sports construction industry in the UK.

www.sapca.org.uk

The SAPCA web site provides a wealth of valuable information for anyone involved in the development of sports facilities. Visit www.sapca.org.uk - for Industry News, Technical Guidance, Exhibitions & Events, the SAPCA Membership Database, and more. Visitors are invited to subscribe to the free SAPCA News Update service, for regular news bulletins.

Further information

The Sports and Play Construction Association operates through its own full-time administration. For further information, including a list of members, please contact SAPCA at the headquarters address below.

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Prologue

From the first considerations regarding the construction of a synthetic turf sports pitch through to the final completion, a clear understanding is required of the process. The processes and decisions that need to be made can be complex and will depend upon many contributing factors.

This code of practice has three main themes:

- General Construction Requirements
- Maintenance
- Resurfacing

The general construction requirements, highlights many different aspects that must be considered when constructing a synthetic turf sports pitch. It includes details from the project design brief to sports lighting and guidance on selecting the correct synthetic turf surface.

The technical guidance provides a detailed approach to how a synthetic turf sports pitch is constructed. The diagram on the following page is designed to help potential clients make the correct decisions at the right times by looking at the ideal routes a project may take from proposal to completion and the information required at each stage.

Maintenance is a major requirement in the longevity of a synthetic turf sports pitch. A maintenance schedule is essential and illustrates what actions need to be performed, when and why. This section details different types of maintenance methods including Grooming, Power Brushing, Deep Cleaning, Moss and Algae Prevention and Stain Removal.

The final section of the code of practice explains how a synthetic turf sports pitch could be resurfaced as performance decreases. This section explains general considerations when dealing with an existing surface, shockpad and base and how the new surface will be installed.

Construction of a Synthetic Turf Pitch

This phase reviews the project brief and considers factors such as; location, sports usage, funding, procurement and project management.	1. Project Brief
This phase includes the development of a business plan, planning application and, if required, funding application. A consultant should be appointed during this phase.	2. Project Feasibility
Prior to the design phase a detailed site invesitigation is reqruied. This includes topographical, geotechnical, electrical and drainage surveys.	3. Site Investigation
This phase includes the production of full design specifications and technical drawings.	4. Design Specification
In this section a review of the tender submissions is undertaken. This includes tender evaluation, short-listing and eventual contractor selection.	5. Tender Process
This phase includes the construction of the facility. If required independent quality control is undertaken to assess build quality and design specification conformity.	6. Construction Period
This section includes the hand-over of the completed project. If required performance teting should be undertaken to ensure compliance. Additionally, a maintenance regime should be provided by the installer/carpet manufactuer.	7. Project Completion
This phase includes the ongoing maintenance programme and warranty period of the instalation. As required performance tests are undertaken to monitor surface behaviour.	8. Aftercare

1 Section One: General Construction Requirements

1.1 Design Considerations

Many factors can affect the design of the facility this section looks at a number of elements which should be considered when developing the design of a proposed project.

1.1.1 Project Brief

To enable the correct design of a facility to be established it is essential that the Project Brief encompasses all possible areas which will have to be investigated. One of the very first elements to establish is why the facility is needed. In some cases this may be obvious in others less so. For projects that will require a large amount of grant funding through sports governing bodies or funding agencies initial talks should take place to ensure that the location and initial design meets with their strategic and design requirements. Once this has been established then the brief can be expanded to look at other aspects such as usage patterns, management, procurement route, in house resources, and if required the ability to spend money on initial studies both from a design and business plan point of view.

1.1.2 Playing Characteristics

Different sports require separate playing characteristics, and their respective governing bodies stipulate precise requirements. Once the priority sport for a planned pitch has been decided, and the governing body consulted, a large number of the design parameters will have been determined. Choosing a priority sport may mean that certain playing characteristics are not ideal for - or even not compatible with - other sports. We would therefore refer the client to the following bibliography:

BS EN 15330-1 (2007) “Surfaces for Sports Areas – Synthetic Turf Surfaces primarily designed for outdoor use – specifications for synthetic turf”

BS EN 15330-2 (2008) “Surfaces for Sports Areas – Needle Punched Carpets primarily designed for outdoor use – specifications for needle punch carpets”

Federation Internationale de Football Association (2008) “FIFA Quality Concept for Football Turf”

Football Association (2005) “Guide to Artificial Grass Pitches for Community Use Parts 1, 2 and 3”

Football Foundation (2004) “Facilities Data Sheet”

International Hockey Federation (2008) “Handbook of Performance Requirements for Synthetic Turf Hockey Pitches Incorporating Test Procedures - The Pitch Handbook”

International Rugby Board (2008) “Regulation 22 - Standard Relating to the Use of Artificial Playing Surfaces”

Rugby Football Union & Football Association (2007) “Artificial Grass Pitches for Rugby and Association Football”

Sport England (Update Due 2008) “Sports Council Design Guidance Notes (Surfaces - Guide to Selection, Multi-Use Games Areas and Sports Lighting)

Sport England and Big Lottery Fund (Update Due 2008) "Guide to the Design, Specification & Construction of Multi-use Games areas (MUGAS)"

Please note: Whilst the information presented within this section is taken from the relevant standards above it is highly recommended that information is obtained directly from the source material to ensure it meets the very latest requirements as these documents are updated on a regular basis. Every effort is made to keep the code of practice up-to-date but there will always be a delay in response to updates.

The above publications stipulate various performance requirements from the synthetic surface for the individual sports such as (please note these lists are not exhaustive):

a) Ball Surface Properties:

- Ball roll
- Ball rebound
- Ball-to-surface friction
- Surface pace (angled ball behaviour)

b) Player Surface Properties:

- Traction coefficient
- Slip resistance
- Sliding distance
- Force reduction
- Vertical deformation
- Abrasiveness
- Head Impact Criteria (HIC)

c) Construction Tests:

- Porosity (or permeability)
- Slope
- Evenness

d) Durability Tests:

- Joint strength
- Tests on simulated use
- Tests including artificial weathering

e) Product Identification Tests:

- Mass per unit area
- Tufts per unit area
- Tuft withdrawal force
- Durability

Individual specifiers should take account of the expected standard of play on the facility being constructed to ensure that, for cost efficiency reasons, the appropriate level of performance standard is specified. Some governing bodies specify different performance requirements depending on the quality (level) of sport to be played on it. For example FIFA specify either a 1 star or 2 star system; and the FIH has global (international) and standard (national) systems. The aim is to ensure that international-level pitches are not being specified for facilities where community standard use is adequate and often more cost effective.

Various combinations of carpet specification, shockpad and base construction will meet a range of different performance requirements. If the client wishes to let the contract on a 'Design and Build' basis, allowing the contractor to design a system to meet the selected performance requirements, he/she should obtain confirmation, by way of test certificates, that the nominated system will achieve these results.

If, however, the client chooses to specify on a 'Method' or 'Recipe' basis by specifying the system he/she requires in detail, then the client must be sure that the system specified will meet the performance requirements needed for the pitch. This will entail retaining an expert with knowledge of synthetic turf systems for the range of sports played on such surfaces. Retaining such a consultant will incur a fee which may be a fixed sum or may be charged as a percentage of the project value but will gave an added guarantee of conformity.

Under any circumstances the completed facility should be tested by an independent specialist test house, to the relevant performance standard to ensure compliance with the performance and safety criteria specified.

1.1.3 Size

The size of any facility should, where possible, be dictated by the dimensions required by the sports to be played. However where a site may not be large enough for full size facilities, sports governing bodies should be consulted to establish the most appropriate dimensions for the pitch, especially where funding is being obtained through the governing body.

Wherever possible, the chosen site should have good access for construction and maintenance plant and be readily accessible for players and spectators on pedestrian paths. Sites closely surrounded by trees are best avoided due to the potential long-term problems of invasive roots and of surface moss caused by overhanging branches.

1.1.3.1 Hockey

The playing area of a hockey pitch is 91.40 m long x 55.00 m wide. For Global and National pitches the International Hockey Federation (FIH) stipulates that there should be an over-run of 3 m at each end and 3m at each side on the same synthetic turf material as the pitch

itself, and an additional 2 m at each end and 1m at each side on a level, firm surface “before any obstruction is encountered”. The minimum area of synthetic turf is thus 97.40 m x 61.00m and the minimum overall area 101.40 m x 63.00 m (See Figure 1).

External to the pitch dimensions the synthetic surface shall continue with the same qualities of material, slope, smoothness and watering facilities for a minimum distance of three metres before any change in playing characteristic of that surface occurs. The surface shall extend a further minimum distance of two metres with a horizontal surface at each back line and one metre at each side line before any obstruction is encountered. These final dimensions may be surfaced with a material which differs from the playing surface.

The width of the playing lines should be 75 mm and they should be coloured either white or yellow. The short lines on the outside of the field should be 300 mm long with the exception of the goal post marks which should be 150 mm long. The FIH introduced a broken line outside the striking circles, as a mandatory requirement for international matches, from 1st March 2000. The line should be marked at a distance of 5.00 m from the outside edge of the circle to the outside edge of the broken line. The line should consist of solid lines of 300 mm length separated by 3.00 m gaps. The adoption of this broken line for other matches is at the discretion of National Associations.

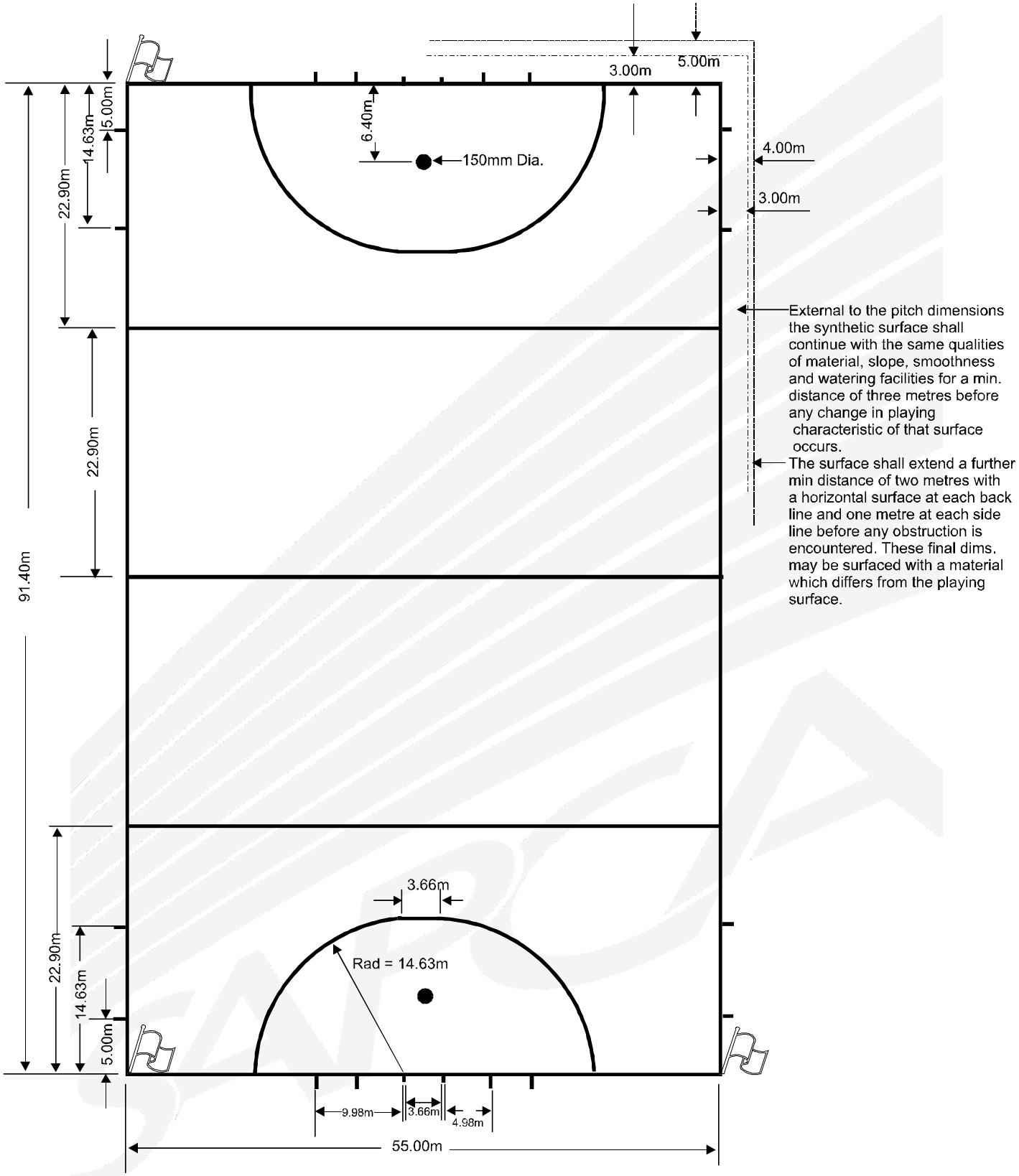

Figure 1: Dimensions of a Hockey Field (not to Scale)

1.1.3.2 Football

In the publication 'Guide to Artificial Grass Pitches for Community Use' the Football Association have laid down specific dimensions for football pitches (see Table 1 and 2)

Table 1: Recommended dimensions for eleven-a side pitches

Age Group	Playing Area		Recommended run-off beyond Playing Area		Total Pitch Size (m)	Recommended Goal Size (m)
	Length (m)	Width (m)	Min at Ends (m)	Min at Sides (m)		
Senior & Youth (U17-U18)	100.00	65.00	3.00	3.00	106.00 x 71.00	7.32 x 2.44
Youth (U15-U16)	82.00	55.00	3.00	3.00	88.00 x 61.00	7.32 x 2.44
Youth (U13-U14)	73.00	55.00	3.00	3.00	79.00 x 61.00	6.40 x 2.13
Youth (U11-U12)	64.00	46.00	3.00	3.00	70.00 x 52.00	6.40 x 2.13

Table 2: Recommended dimensions for other games

Game	Age Group	Playing Area		Recommended run-off beyond Playing Area		Total Pitch Size (m)	Recommended Goal Size (m)
		Length (m)	Width (m)	Min at Ends (m)	Min at Sides (m)		
Mini-soccer (seven a-side)	U9-U10	55.00	36.50	3.00	3.00	61.00 x 42.50	3.66 x 1.83
	U7-U8	46.00	27.50	3.00	3.00	52.00 x 33.50	3.66 x 1.83
Small sided football (five-a-side)	Senior	42.00 to 25.00	25.00 to 15.00	No run-offs required as the rebound boards or fencing enclosing the pitch from the boundaries			4.88 x 1.22
	Junior	The ratio between length and width should where possible be 2:1					3.66 x 1.22
	Mini						2.44 x 1.22

The FA also requires that when projects are being funded by the Football Foundation, goal recesses are included for storage of goals and where possible the facility should be a full size senior pitch. Figure 2 illustrates the typical dimensions of a full size football pitch.

Where pitches are required for dual use, hockey and football, the overall dimensions of the synthetic surface will depend on the level of football use required. If the predominant use is at senior level, the dimensions will adequately accommodate a standard hockey pitch and run-outs within the football enclosure. If the predominant use is hockey, the standard pitch and run-outs will accommodate a youth size football pitch.

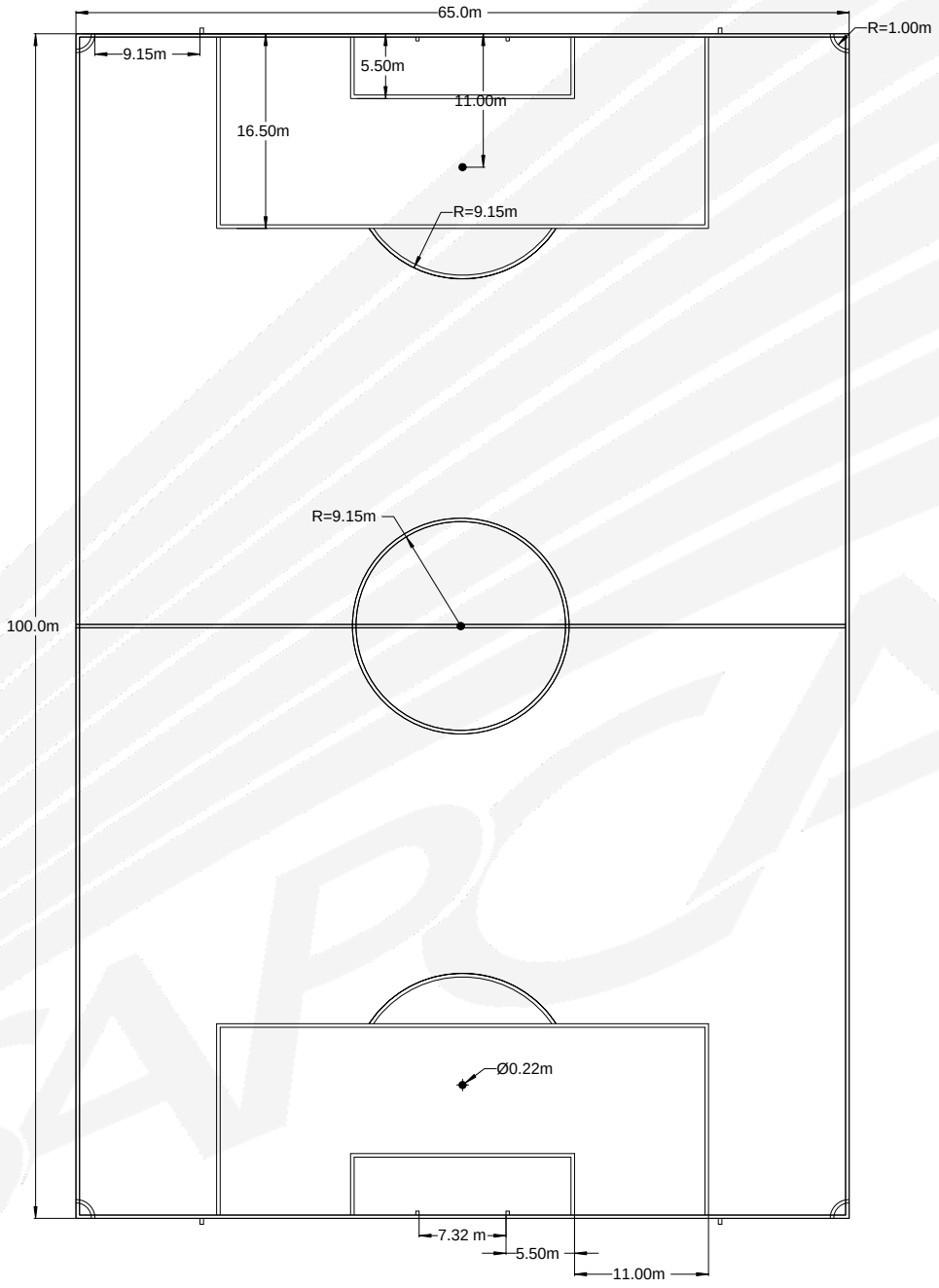

Figure 2: Dimensions of a Football Pitch (FA Senior & Youth) (not to Scale)

1.1.3.3 Rugby

The International Rugby Board (IRB) states that the length and breadth of the playing area are to be as near as possible to the dimensions illustrated in Figure 3 (A maximum length of 100.0 m and width of 70.0 m). In addition a minimum 5.0 m run-off at the sides and ends are required. The recommended size for training pitches is 55.0 by 36.5 m with a minimum 3.0 m run-off.

1.1.4 Orientation

In order to avoid facing directly into low afternoon and evening sun, the preferred orientation for a pitch axis is approximately north-south.

1.1.4.1 Surface Level Tolerances

Although some governing bodies permit small longitudinal and transverse gradients, practical experience has shown that problems of long-term carpet stability are more commonly found on installations that have been constructed to steeper gradients. For this reason it is recommended that longitudinal falls and cross-falls are restricted to a minimum.

1.1.4.2 Gradients

Longitudinal gradients (pitch slope): The FIH requirement is for a longitudinal fall of less than 0.2 % for Global pitches and less than 1.0 % for Standard pitches. The FA and RFU requirement for slope is of no more than 1 % in any direction with a recommendation of 0.5%.

Cross-fall gradients (pitch profile): In order to preserve unbiased ball roll characteristics, the FIH suggests an ideal gradient across the pitch of 0.4 % maximum. However, gradients of up to 1 % are acceptable for Global pitches whilst no maximum requirements set for Standard pitches other than a recommendation of 1%. It should be noted that steeper gradients have tendency to cause movement of the synthetic turf carpet.

1.1.4.3 Smoothness

The FIH requires a maximum deviation of 6 mm under a 3 m straight edge for Global and Standard pitches which matches the requirements of BS EN 15330. Both FIFA and the FA require a maximum deviation of 10 mm beneath a 3 m straight edge; however, the requirements for soccer laid down in BS EN 15330 are 15mm.

There should be no significant height difference or separation at joints. The FIH imposes a maximum allowance of 2 mm. The FIFA requirement also imposes a maximum of 2 mm under a 300 mm straight edge.

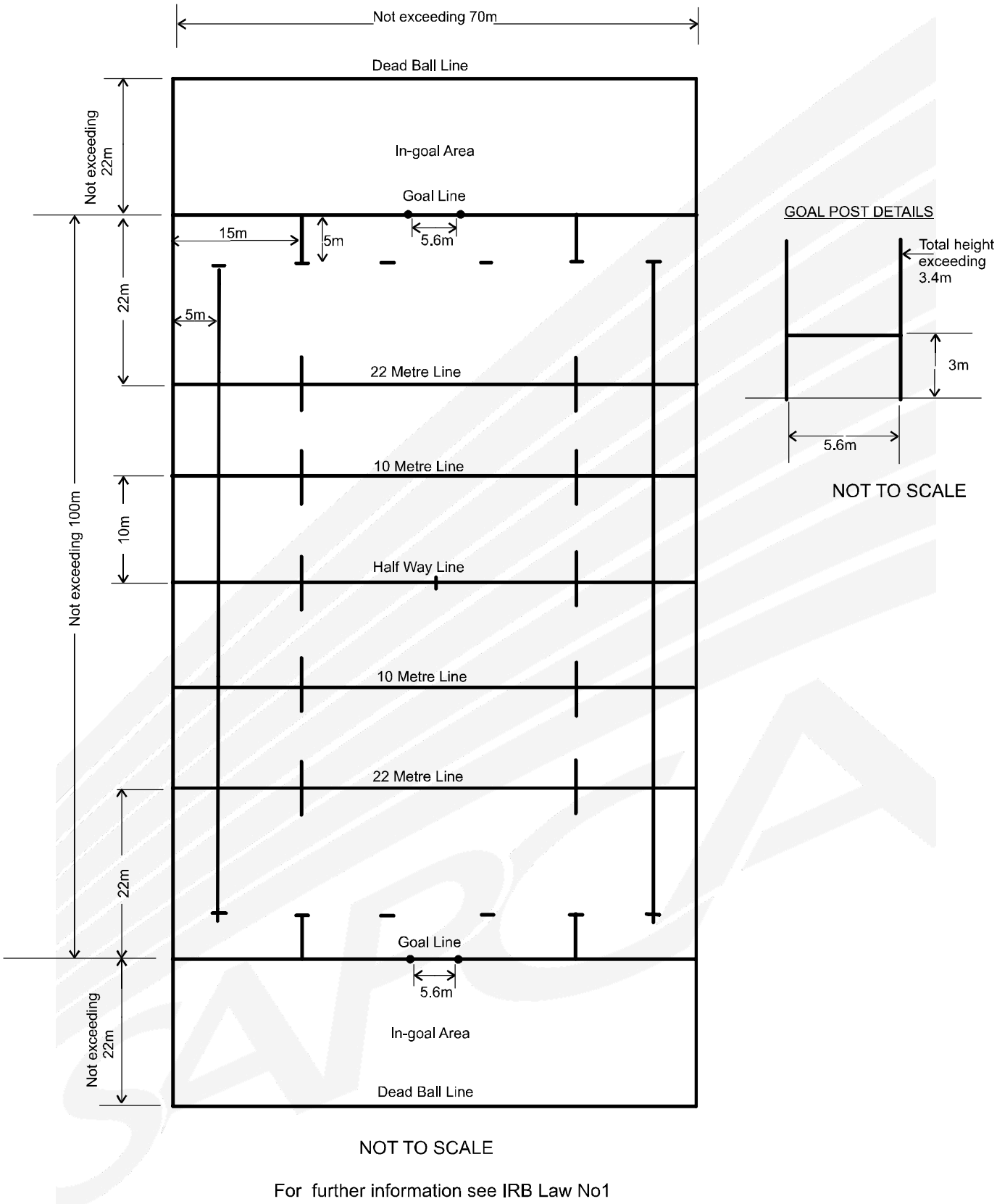

Figure 3: Dimensions of a Rugby Union Pitch (not to Scale)

1.2 Earthworks

The greatest risks and uncertainty arise from site ground conditions. The earthworks design therefore needs careful attention before starting construction. The extent of earthworks depends on ground conditions and site topography. Pitches are laid to very flat gradients, so sloping sites will require more extensive earthworks compared with relatively flat ones. The cheapest option will be the one that produces the least amount of spoil or minimises the amount of imported stone. The most expensive tasks are transporting earthworks materials to and from site and the disposal of surplus materials.

1.2.1 Information Gathering

To confirm the scope of earthworks and the drainage design, you need the following information:

- Topographic survey
- Site investigation

To establish how the pitch will fit into the site, you need an accurate survey that should include the following information:

- Detailed levels across the site
- Site boundaries and existing fences
- Existing trees together with their species and height
- Surface features relating to drainage and services such as ditches, manhole covers and overhead lines. Any manhole covers should be lifted and the purpose, contents and depths of holes recorded
- Any other features such as roads and buildings
- Services, underground and overhead

The information underlined above forms part of the legal obligation of a client or his advisor to provide under the CDM Regulations 2007. Whether it is intended to use a traditional or a Design and Build contract, the designer needs this information to clarify the site constraints and determine earthworks quantities.

A site investigation involves examining the underlying ground conditions and this is vital for earthworks design. For Design and Build contract, a full geotechnical or geoenvironmental (for some difficult sites) investigation must be undertaken and the full report included in the Tender Documents along with a full Design Criteria, to enable a realistic design to be produced by the tenders. Without one, there is a real risk of cost over-runs as a result of finding unforeseen ground conditions.

The scope of the site investigation depends on site conditions and should include examining and sampling the ground conditions on site together with laboratory testing. The information requirements will include the following:

- Ground strength
- Groundwater level
- The sub-soil hydrolytic conductivity
- Topsoil thickness
- Soil particle grading (for coarse-grained soils)
- Soil plasticity indices (for fine-graded soils). Soil plasticity index is a measure of soil clay content which is vital to assessing shrinkage potential
- An engineering description of the ground
- Surface water outfalls

For more difficult sites such as river flood plains, steeply sloping sites or derelict sites, more extensive site investigation will be required. Again, you need professional and site-specific advice. For sites that have previously been landfill sites, a full geoenvironmental report will be required to assess the impact on changes to the drainage, also contaminant testing will be required in order to assess the ability to move or remove soils from the site.

1.2.2 Site Levelling and the Formation

Pitches need to be founded on competent ground. Topsoil, turf and vegetation are not suitable and therefore must be stripped from the site. Topsoil can be reused for landscaping or spectator mounds if space allows.

The geotechnical investigation report should provide information which will enable the designer to assess the suitability of the formation layer. There could be circumstances where the formation is not suitable without modification or strengthening. The most common types of formation modification are lime/cement stabilisation or the addition of a plastic grid above the formation and or within the sub-base formation.

The ‘formation’ is the level ground on which the pitch construction is built. It is preferable that the formation is natural ground because soil is usually stronger when it is undisturbed. Relatively flat sites can be excavated down to natural ground (‘cut to solid’) without producing large volumes of spoil.

Cutting to solid will be less practical for steeper sites because much more soil has to be excavated. If excavated soil cannot be used elsewhere on site, it has to be transported to a tip, which is very expensive. In these situations, re-using excavated soil as fill to build up the formation (‘cut and fill’) is much cheaper. However, re-used soil has to be compacted by mechanical plant to obtain adequate strength and density. Compacted strength and density depend on the type of soil, its water content and the amount of compactive effort applied. All filling should be carried out in layers not exceeding 150 mm thickness, and each layer should be compacted to the requirements of Clause 612 of the specification for Highway Works, before the next is spread.

The formation should be treated as part of the finished pitch. It is vulnerable to softening in wet weather and therefore has to be covered as soon as possible. Any soft spots in the formation must be dug out and replaced with imported crushed granular material, such as

that used for the sub-base (see Section 1.5). The finished formation should be trimmed to a minimum tolerance of ± 25 mm.

1.2.3 Slope Stability

In general, steep cutting into slopes brings a risk of landslip. A landslip is a mass movement of sloping ground; they can cause widespread damage and be dangerous. They may occur immediately or much later and can be a long-term danger. Not all slopes are unstable and landslip hazard can be avoided by using correct techniques. If you need to cut into steep slopes to make the pitch fit the site, specialist advice is essential, as retaining structures may be required.

Cuttings into stable ground should be made as shallow as possible to allow ease of maintenance. Allowable cut angles will be site-specific.

Depending on site constraints, there should be minimum 1 m margin from the pitch surround-fence line to the edge of any embankment.

1.3 Weed killing

Following excavation and levelling, the site should be treated with an appropriate residual herbicide. Application should be by a competent person trained in accordance with Health and Safety regulations. It is not possible to guarantee total prevention of future weed growth. To do so would necessitate the use of herbicides of such toxicity, or in such quantity, as to constitute a danger to humans and wildlife.

1.4 Drainage

A suitable drainage scheme should be designed and installed which will:

- Ensure that all surface water is removed from the site at a rate which will safeguard against surface flooding occurring.
- Not allow excess water to remain present in the construction which might result in a reduction of the load-bearing capacity of the formation or in any frost damage to the construction.
- Protect the installation from the effects of ground or surface water from the surrounding areas.
- Meet the requirements of the Environmental Agency or Local Water Authority, this aspect is usually required at planning stage for most facilities, therefore a drainage design will normally form part of the clients design criteria.

A basic design will have lateral drains incorporated beneath the pitch, the centres of which shall be determined by the composition of the subsoil and the designed infiltration and outfall rates. Centres usually range from 5 m to 15 m. The ends of lateral drains should be capped to prevent contamination, and connectors should be used when joining lateral drains to collector drains. Collector drains should be located on the outside of the perimeter edging.

Perimeter drains (which may act as collector drains) should be installed at the toe of any embankments to prevent run-off from surrounding areas. Silt/inspection chambers should be constructed where perimeter/collection drains change direction, and the provision of rodding

eyes should be included at the head of collector drain runs for ease of access for maintenance.

Drains usually consist of perforated plastic pipes, bedded on, and backfilled with, clean stone which should then be compacted. No drains should have less than 150 mm cover over the top of the pipe, and no drain should be laid to a fall of less than 1:200 unless advised by manufacturers' instructions. In certain sub-soils where silting-up may be a problem, a geotextile membrane may be used to line the trench prior to backfilling. The installation of a full-size synthetic pitch may disturb any existing land drainage and render it ineffective. Where existing land drains are severed they should be connected into the new perimeter drain.

The Environmental Agency and Local Water Authorities now have strict guidance regarding the outfall of drainage systems. Although the design of pitches is usually a porous one, by installing a drainage system in order to keep the surface and base dry and therefore not subject to frost heave and possible damage, the design will concentrate the water to one outfall point, traditionally this has discharged into an existing outlet or natural watercourse or if ground conditions permit, soakaways. However, it is now common practice for planning authorities to submit an application for a pitch which includes a drainage system to the Environmental Agency or Local Water Authorities for their approval, as part of this process it is likely that they will ask for the drainage design to be proven and they may put limitations on the amount of water that may be discharged to a water course or surface water drain. In such cases it may be necessary to use an attenuation system to store the water prior to discharge. Due regard must be given to location and size of either attenuation systems or soakaways and to ensure that the calculations regarding their design are undertaken by a drainage expert. Sometimes planning authorities will request that the design is approved prior to permission being given, in which case most schemes will require a full drainage design prior to the tendering, in which case the client or his advisor will undertake the role of designing the system, written approval from the successful contractor under a design and build contract will therefore also be required. Sometimes the planning authority will ask that as part of a condition the design is approved prior to construction starting, in which case under a design and build contract the successful contractors design can be submitted prior to starting on site, however this may cause some delay in starting the works on site.

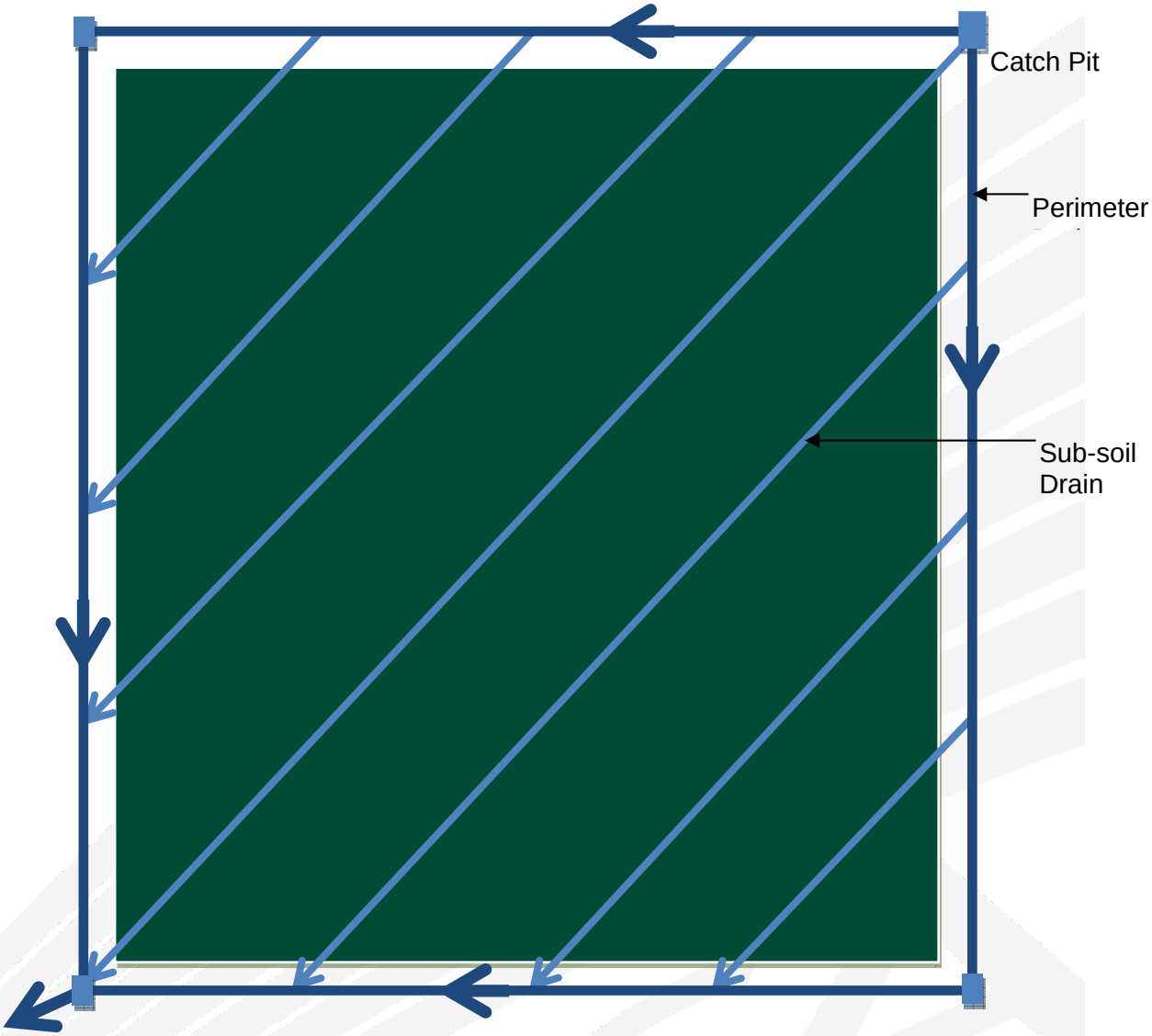

Figure 4 **Typical Drainage Layout for a Synthetic Turf Pitch (not to Scale)**

1.5 Sub-base

The sub-base to any synthetic pitch should be designed to meet the following criteria:

- It should be capable of supporting - and transmitting to the existing ground - the loads of all vehicles, plant, machines and materials to be used in the construction, without causing deformation of the site.
- After the pitch is built, the sub-base should be capable of supporting and transmitting all loads on the playing surface without permanent or long-term deformation of the playing surface. Such loads arise mainly from players and maintenance equipment.
- It should ensure that water, whether rainwater or natural ground water will drain away freely through the sub-base material, either into the natural subsoil or into the drainage system.

Foundations should be constructed using hard, clean, crushed frost-resistant aggregates. Virgin rock has been commonly used for the construction of the sub-base layer. However, the use of recycled material is now considered acceptable practice. The grading of the sub-base material must be such as to provide stability while at the same time remaining porous. If recycled materials are to be used in the sub-base construction then it is essential that they come from a reputable source and should be graded and certified as meeting the requirements of the Specification for Highways Works series 0700, clause 710. It is recommended that if recycled materials are used then they are topped off with a minimum of 50 mm of virgin rock material, this will help to ensure that, if they have high cement/lime content that calcification of the upper layers does not occur. The material should be laid in layers not exceeding 150 mm, each layer being compacted before the next is laid. The minimum compacted thickness of sub-base stone should be 300 mm, unless formation conditions dictate otherwise, situations where an extremely good formation is found may allow the sub-base depth to be decreased, conversely poor formation conditions may require an increase in sub-base depth. Upon completion there should be no detectable movement under the roller. The sub-base material should be compacted to the requirements of clause 701 of the Specification for Highway Works. The surface level tolerance should be within ±10 mm of the design level, and, when checked with a 3 m straight edge, there should be no deviation greater than 10 mm.

In order to prevent contamination from the sub-grade it is normal practice to install a geotextile membrane on the formation prior to installation of the sub-base.

1.6 Perimeter Edging

A perimeter edging is normally installed to contain the synthetic surface and, in the case of some non-sand-filled and some sand-dressed products, to anchor the carpet. Pre-cast concrete kerbs to BS 7263:2001 or preformed sections are usually used. Whichever detail is chosen it must be firmly bedded in concrete and be straight and level. There should be no deviation detectable by the human eye, and the level tolerances of Section 1.1.4 should apply.

The level of the edging must not be higher than the synthetic surface, since this would constitute a hazard to players in the form of a trip-edge and a danger to spectators should hockey balls strike the kerb and fly.

1.7 Base Construction

Once a suitable sub-base has been designed for the specific ground conditions encountered on any site there are two main alternative constructions which could be used for the base: a bound base (engineered) normally of asphaltic concrete, or an unbound (dynamic) base formed either of stone, as a separate layer on top of the sub-base or as an extension to the sub-base. There are also a couple of less common types of base, those formed of sand and also those formed of a mixture of lava and rubber granules.

The choice of which type of base should be used for any specific site will depend on many factors. The factors which should be considered when identifying which type of base is suitable are as follows:

- Final surface regularity requirements
- Consistency of playing characteristics
- Formation susceptibility to movement
- Longevity of surface tolerances
- Cost

Bound bases provide a very stable surface. They are essential for maintaining the tight surface level tolerances required for some sports over the life expectancy of the base (around 25-30 years). They are inherently more stable than unbound bases and provide a better guarantee of consistency of playing characteristics over the pitch surface both initially and during its life. Whether a shockpad is required or the carpet is being laid directly onto the base, a bound base is much easier to install those materials on during the construction process, as the surface does not move under the machinery required.

Bound bases also offer better permeability rates over most unbound stone bases as the latter has to be held together with a percentage of fine material in its uppermost layer. Furthermore, it is possible to specify bound bases using international standards, whereas there are no published standards for unbound bases.

The main advantage of unbound bases is that they can benefit from a lower initial capital cost than bound bases. However, it may be necessary to increase sub-base depths to improve surface level tolerances if poor ground conditions prevail, in which case the benefit of cost may be reduced. Also it may become necessary to rectify deviations in surface regularity during the life of the synthetic surfacing which can be problematic and costly.

A further advantage of unbound bases is their ability to deform under high impact loads thus improving comfort and safety (without a shockpad) when a player contacts the surface under heavy impacts. However, repeated impacts and transmission of loads from heavy machinery (including maintenance vehicles) may have a detrimental effect on surface regularity overtime.

In most situations SAPCA recommends the use of bound bases.

1.7.1 Bound Base Construction

Bound bases are the traditional form of road construction consisting of a single course or two courses of open-textured Asphaltic Concrete laid and compacted to BS 594987:2007. Figure 5 illustrates a typical cross section of a synthetic turf pitch.

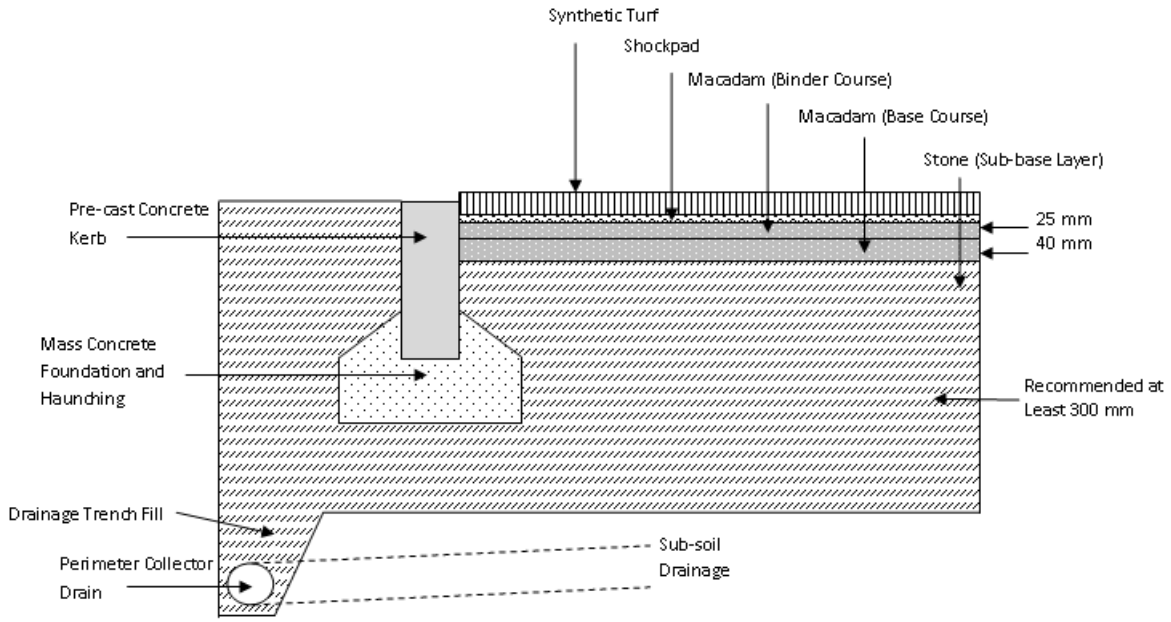

Figure 5: Typical Cross Section of Edge Detail on a Synthetic Turf Pitch on a Bound Base (not to Scale)

1.7.1.1 Two-course Construction

An open textured base course consisting of 40 mm nominal compacted thickness (minimum compacted thickness not less than 30 mm at any point) of 14 mm or 20 mm nominal-sized aggregate, plus an open textured binder course consisting of 25 mm nominal compacted thickness (minimum compacted thickness not less than 15 mm at any point) of 10 mm nominal sized aggregate, both to BS EN 13108-7.

1.7.1.2 Single-course Construction

An open textured binder course consisting of 40 mm nominal compacted thickness (minimum compacted thickness not less than 30 mm at any point) of 10 mm nominal sized aggregate to BS EN 13108-7.

The choice of single-course or two-course construction will largely depend on the available budget and the design criteria of the installation. Two-course construction was originally used to ensure that the construction complied with the required tolerance on surface smoothness (Section 1.1.4). The current technique of using laser-controlled paving machines to install the top layer of sub-base stone as well as any bituminous courses means that these tolerances can now be achieved with a single course of macadam.

1.7.2 Unbound Base Construction

The most common type of unbound (dynamic) base consists of crushed stone. This can be as a separate designed layer on top of the sub-base or as an extension to the sub-base. This base may have a geotextile membrane above and/or below it. The choice of the grade of stone, the thickness it is laid and its degree of compaction will have a profound effect on the ultimate playing characteristics of the pitch. The fines content of the upper layer of stone must be constantly checked to ensure that the required degree of porosity is maintained. If the fines content becomes too high it may be prone to movements with changes in moisture content and over time; therefore maintenance of level tolerances and drainage properties may be adversely affected.

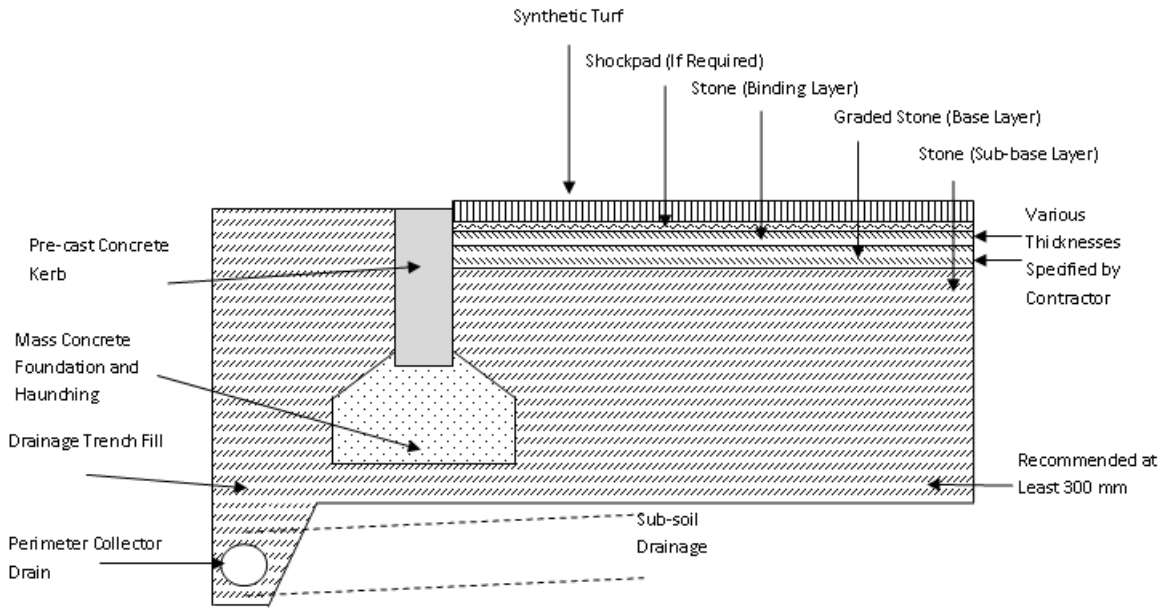

Figure 6: Typical Cross Section of Edge Detail on a Synthetic Turf Pitch on an Unbound Base (not to Scale)

1.8 Shockpads

The introduction of a resilient layer between the base and the synthetic turf is used to provide a degree of comfort to players and to create defined performance characteristics and safety requirements for specific sports. Its correct design may also help systems to meet the required playing characteristics over longer periods of time. There are a number of ways of achieving this resilient layer, with assorted laid in-situ shock-pad systems, prefabricated or combinations of both. Typical components of in-situ systems are rubber crumb/shred mixed with a resin binder. In the case of pre-formed systems, the shock-pad is delivered to site as rolls or tiles of prefabricated material. In the case of in-situ systems the components are mixed on site and laid to form a continuous layer of material.

1.8.1 Pre-formed Construction

1.8.1.1 Pre-formed Rubber Rolls

The type and thickness chosen will be dictated by the priority sport, although several different options may be able to provide a surface that complies with the requirements in terms of playing characteristics.

Flat rolls generally have a thickness in the range 8-15 mm.

Dimpled shock-pads have a flat upper surface, with a regularly spaced pattern of undulations on the lower surface to form a rounded 'egg box' type structure. Careful consideration should be given to the use of this type of shockpad. Experience shows that carpet movements are more likely with this system unless steps are taken to anchor both the shock-pad and carpet. SAPCA does not recommend the use of dimpled shock-pads.

Rolls are usually 1.25 m in width. Lengths vary depending on thickness, but are normally between 25 m and 35 m but can be supplied in any length up to 65 m if needed.

Rolls of shock-pad may be laid perpendicular or parallel to the subsequent rolls of synthetic turf carpet. Whichever arrangement is used, it is important that all rolls should be laid straight and true with the minimum of distortion. Head joints should be staggered by at least 1.0 m. Prior to head jointing, each roll should be allowed to reach its optimum length before trimming. No joints should have a variance in height greater than 2 mm. All joints should be seamed and taped to prevent gaps appearing from movement of the rolls.

1.8.1.2 Other Pre-formed Materials

Several other forms of proprietary shock-pad are manufactured, marketed and installed by contractors in the UK, all with their own individual properties and requirements for laying. These include pads of closed-cell foam; nylon filament; needle-punched, expanded polyethylene or vertical fibre systems; some of which are combined with rubber granulate; pads which are an integral part of the carpet system; various designs of prefabricated mat and tile, etc. Each having different features and benefits which the manufacturer will confirm and demonstrate before a choice of system is made. Careful evaluation of pre-fabricated systems and laying processes is essential when making comparisons between products. Experience has shown that carpet and shock-pad movements may prove more likely if the shock-pad is not fully jointed and/or is not dimensionally stable.

1.8.2 In-situ Construction

Shockpads constructed in-situ normally vary in thickness from 10 mm to 35 mm and consist of a polyurethane binder mixed with rubber crumb/shred. The thicker pads also may contain pea gravel or other smaller aggregates. The rubber particle shape, size and grading needs to be considered along with the binder type and content.

The precise specification and laying techniques will vary depending on the installer and the priority sport. As with preformed pads, no joint should vary in level by more than 2 mm and the completed mat should comply with the level tolerance requirement of the finished installation.

Whichever shockpad system is to be installed, a reference sample should be obtained at tender negotiating stage so that the installed shockpad can be checked for consistency of material.

Careful monitoring procedures and quality control checks should be in place to ensure that any variations in thickness of an in-situ laid pad do not affect the playing performance and compliance with the reference sample.

1.9 Synthetic Turf

There are a large number of synthetic turf systems on the market, most of which look quite similar but may be made of different materials, manufactured by different techniques and designed for use in different ways. There are many fibre producers and even more carpet manufacturers and installers. It is therefore essential to establish or specify the precise materials and carpet types required for specific sports governing bodies' performance requirements to be met. The preferred playing characteristics should be specified at tender stage, and each tender submission should be accompanied by independently certified proof of the proposed system's performance together with a reference sample.

There are six major types of synthetic turf:

- Non-filled
- Water-based
- Sand-filled
- Sand-dressed
- Rubber/sand-filled long pile turf (3rd Generation)
- Needle-punch carpets

Other variables distinguishing different synthetic turf carpets include;

- The polymer used for the fibre yarn. The two main groups used are polyolefins (which include polypropylene and polyethylene) and polyamides (nylons, not very common at present) although blends of polymers are also used. The basic polymers are modified chemically to produce differing properties such as durability, frictional resistance, resistance to weathering etc.
- The cross-sectional area and shape of the individual ribbons of fibre, this varies considerably from product to product. The unit of measurement for the weight of the fibre is Dtex - the higher the Dtex the greater the weight of fibre per unit length. The shape of the fibres can vary from fibrillated flat ribbon yarns to straight flat bladed monofilament yarns to C shaped yarns.
- The method of carpet manufacture. The main methods are tufting and needle punching past methods also included knitting and weaving. In a tufted carpet (the most common type of manufacture), the fibre is tufted into a 'primary' backing cloth, normally manufactured from woven polypropylene, and the individual tufts are anchored by the application of a latex-based secondary backing material. Needle-punching is a completely different form of manufacture with the fibre in the pile

forming both the pile structure and the majority of the backing cloth. The fibres are needled into a flat primary cloth then secondary needled to pull through the desired quality and configuration of pile. Needle-punching is primarily applicable to sand filled surfaces. In a knitted carpet, the tufts are knitted into the structure of the carpet and rely on the strength of the knitted web rather than the adhesive strength of the latex. Knitted carpets tend to cost a great deal more to produce. Woven carpets are similar to knitted in that the pile (or tufts) is mainly held in place by the weaving web, rather than the latex backing, giving good tuft withdrawal qualities. This system also costs a great deal more to produce and consequently is not very common.

- Pile height and pile density. Pile density has two components, the density of tufts per unit area and the composition of each tuft in terms of number and thickness of fibres.

1.9.1 Non-filled

Non-filled systems differ distinctively in design and appearance from filled pitches. There are many products on the market, the very first synthetic turfs were un-filled and there are still some systems available now which are installed with no irrigation system. There are a number of systems available of the long pile length variety designed for predominantly soccer use which have a very dense pile and do not require sand or rubber infill.

1.9.2 Water-based

Many unfilled products require the use of water to change their surface properties when in use. They are often referred to as `wet fields` or `water-based pitches` these types of products are in the main used for Hockey. The water is applied via an irrigation system to the surface immediately before play. The presence of water reduces the player/surface friction, modifies the speed of the hockey ball and cools the surface in hot climates. When designing a non-filled installation, due consideration must therefore be given to the means of applying sufficient water over a short period of time. A direct result of the incorporation of a suitable irrigation system and the denser pile construction is reflected in the cost of installation being considerably higher than sand-filled systems (see section 1.14).

The extra mechanical forces applied to non-filled carpets lacking the support of a sand bed also mean that the more expensive knitted construction is often (though not always) used. Both polyolefin and polyamide yarns may be used. Polyamides have the advantage of absorbing and retaining some water, but are more prone to give friction burns when players fall.

The current FIH Performance Requirement is that a pitch and overruns should be capable of remaining uniformly wetted for at least 45 minutes, maintaining a surface temperature of less than 50°C even in the hottest conditions of direct solar radiation. It is further specified that an average of 3 mm depth of water precipitation over the pitch should be sufficient to achieve this.

1.9.3 Sand-filled

Sand-filled systems are significantly less expensive than non-filled as the pile density can be reduced due to the sand fill. The tufting method is the most widely available. Polyolefin, polyamide and mixed co-polymer yarns are used. The silica sand in-fill should consist of non-abrasive, non-staining, well rounded, dust-free particles of uniform grading and density, free from extraneous contaminants. The sand infill is normally taken to within 3 mm of the fibre tips. The sand and fibre combine to form the characteristics of the playing surface and it

is essential that the level of sand fill is maintained throughout the life of the facility. Sand-filled systems do not normally require to be irrigated in the UK climate.

1.9.4 Sand-dressed

A derivative of the sand-filled system is the so-called 'sand-dressed' carpets. These are intermediate in properties between traditional filled and non-filled carpets. They have a shorter, denser pile than the standard filled turf systems with a reduced quantity of sand fill.

Sand-dressed systems are commonly specified as alternatives to the non-filled, irrigated fields for hockey.

1.9.5 Third Generation (3G)

The 'third generation' system has found favour with the football and rugby governing bodies and has been approved for football and rugby at the highest level. (See the FIFA, UEFA, RFU and IRB requirements referred to in Section 1.1.1).

Surfaces falling into this category differ from standard sand-filled systems in the height of pile, commonly up to 65mm long, and the infill used, normally 2/3 of the pile height. The infill to the 3G system is normally designed to provide some of the shock absorption by using rubber granules. The rubber granules are sometimes mixed with sand or incorporated with sand in layers. Among the benefits this system brings to sports such as football and rugby, is that a full football stud and metal BS kite-marked rugby studs can be used on the surface and the football/surface performance properties are closer to natural grass than previous synthetic turfs.

1.9.6 Needle-punch Carpets

Needle-punch carpets have been around for a considerable amount of time, they provide an alternative which can provide excellent playing characteristics and durability. Generally they are around 8-16 mm thick and have a fine sand filling applied after installation; they are installed in much the same way as traditional synthetic turf.

1.9.7 Jointing and Play Lines

The carpets are manufactured on looms, which normally have a maximum production width of around 4 metres. The strips of carpet, produced by this method, need to be joined on site to form the continuous surface of the pitch. This is normally achieved by using a backing tape under the butted joint of two adjacent carpet strips. Both edges are bonded to the backing tape to form a continuous seam. These seams are normally laid across the width of the pitch.

Good practice methods in forming strong adhesive bonds, between the back of the carpet and the seam jointing tape, are very important as they must always meet the joint strength specifications for the sport played on the surface. The key points in producing high quality joints and line installations are:

- Use of correct quality and width of jointing tape and positioning of seam joint centrally along tape (wider tape for line installation)
- Application of adequate pressure to the bonded seam whilst adhesive curing takes place

- Awareness of limitations of adhesive in adverse weather conditions.

In some systems, the adjacent carpets are stitched together using a purpose designed machine. This system is only suitable for carpets with a backing and stitch pattern compatible with the stitching process.

Play lines within the playing surface can be incorporated during manufacture, using a different-coloured fibre, or can be inlaid (cut in) on site. Play lines may also be painted but these can only be regarded as temporary. Depending upon climatic conditions, dryness of carpet and depth of infill such lines may only last a couple of weeks.

1.10 Quality Control

To ensure that all components used during the construction of a synthetic turf pitch and that the entire construction meets the specified requirements a system of quality control should be established with the contractor and independent checks on materials and workmanship should be carried out throughout the construction period. This is as important for the client as for the contractor in checking sub-contractors work.

1.10.1 Workmanship

The quality of the workmanship should be checked at various 'key' stages during the construction process against the specification for the works. Such stages may include the following:

- At completion of the formation, to check size, levels and gradients
- At completion of the construction of the drainage system, to ensure that all connections have been made and that the correct falls have been made in pipe work
- At completion of the installation of the sub-base, to check that the correct depth has been installed and that level tolerances have been met
- At completion of the base again to check that level and thickness requirements have been met
- At completion of the shockpad to check thickness
- At completion of the surface to ensure consistency of infill depth across the pitch

1.10.2 Materials

Shockpad and carpet materials delivered to site should be checked against the reference sample for:

Shockpad

- Tensile Strength
- Density
- Thickness

- Weight per unit area

Carpet

- Fibre type and Dtex
- Pile length. This should match the nominal value to ±1mm when tested using the appropriate test method.
- Pile density in terms of tufts per square cm
- Total weight per unit area
- Tuft withdrawal force
- Quality of backing materials
- Pile filling materials

Seams and Line Markings

- Peel in the case of adhesive bonded seams
- Tensile strength in the case of stitched or lap bonded seams

1.10.3 Performance Testing on Completion

The specification for any pitch should include the specific sports performance requirements dictated by the sport to be played. These performance requirements are specified in a number of ways, either to sport's governing body requirements or to British/European standards, as detailed in section 1.1.2 of this document. Independent performance testing should be carried out on the completed facility, where possible prior to handover. It is recognised, however, that some type of synthetic turf do not reach their normal playing performance until the pile filling has settled into the carpet pile which may take up to a couple of months to occur. The purpose of these tests is to ensure that the completed facility meets the requirements of the works specification, and if funded by a sport's governing body, that their requirements have been met. Once handed over, the facility should be tested prior to the end of any defects liability or maintenance period and also at the end of the warranty period if a performance based warranty was required. Furthermore, some sports governing bodies require annual or biennial retesting for certain levels of competition.

Please note: some sports governing bodies and funding agencies require the performance testing is undertaken by an approved (accredited) laboratory. A list of these can be provided by the relevant governing bodies or funding agency.

1.11 Fittings

Freestanding equipment is preferred for fittings such as goals, because sockets, in time, may present a health and safety risk from trip edges. The investment in good-quality fixtures and fittings will pay dividends throughout the life of the facility.

All freestanding equipment should be substantial and robust in design whilst remaining easily manoeuvrable. When in use, freestanding equipment must be anchored by methods

approved by the equipment supplier to prevent overturning. The Football Association have produced guidance in the form of a document entitled Football Goals Guidance Notes: 2006. This is available from the FA web site. This states that all goals should conform to BSEN 748:1998, BS 8461:2005 and BS 8462:2005.

The load from the equipment should be equally distributed to the surface with no sharp edges protruding. Safety warning signs should be adequately displayed.

Equipment should not be stored on the pitch surface or within the overruns for health and safety reasons. Separate storage areas must be provided for this purpose.

1.12 Surround Fencing

The choice of surround fencing is usually dictated by the priority sport, site constraints and budget. The three basic functions of a surround are to:

- Retain and or rebound balls within the playing area
- Allow spectators to view the game safely
- Security of the facility

In some locations other major considerations may include security and the need to keep out animals.

Each site will have its own specific requirements in terms of design and available budget.

A good fencing contractor should be able to demonstrate a variety of options and advise on the advantages and disadvantages of each fencing system.

SAPCA has produced the following Code of Practice; The Construction and Maintenance of Fencing Systems for Sports Facilities (First Edition: July 2006). This document looks at many aspects for the choice of a fencing system and also lays down requirements for its construction and maintenance to which all SAPCA fencing contractors adhere.

1.13 Sports Lighting

The inclusion of a sports lighting system in the construction of a synthetic turf pitch is sometimes essential to ensure that the pitch is commercially viable; in fact some funding agencies stipulate minimum hours of use which will mean that a lighting system is required. Because of the sensitive nature of sports lighting, planning authorities may impose restrictions which are not possible to meet or which will mean that the chosen location for a pitch build may not be possible. Very careful consideration therefore needs to be given during the design, planning and construction phases of a facility build in this respect. Specialist advice will be required to ensure that the design of a system meets the planning authority guidelines.

Specialist sports lighting designers and contractors will need to adhere strictly to any conditions imposed by the planners. SAPCA is in the process of writing a Code of Practice for Sports Lighting which will be published in 2008.

1.14 Irrigation

1.14.1 General

It is recognised that the design and installation of an irrigation system is a specialist supply service and, as such, the pitch contractor will seek an appropriate specialist system to meet the sports requirements. Water based surfaces are the most common synthetic turf pitches that require an irrigation system.

As was discussed in Section 1.9.2, non-filled carpets, installed for field hockey require watering to comply with the requirements of the FIH. The FIH are trying to reduce/remove their dependence on water by encouraging alternative systems that require less or no water to perform at the highest standard. However, until this is achieved a suitable irrigation system is required.

The system will normally comprise of the following: 6 variangle rain guns (adjustable arc and trajectory) fitted with intermittent dynamic jet breakers to influence uniformity. Additional pop ups will normally be specified to further water goal areas on days of high evaporation or for short/long corner practice without having to utilise all rain guns.

1.14.2 Rain Guns

The rain guns will normally be fitted with 27.5 mm taper bore nozzle, which will deliver 66.73m^3/hr at 5½ bars with a throw of 58.5m at 24°. They should be configured to operate to provide a result of 3mm application of water in 15 minutes (ideally 10 mins). Rain guns behind the goal area should be designed such that they do not point directly at the surface. The central irrigation risers shall be surface mounted to avoid obstructions pitch side. Pop up rain guns behind the goals shall be located outside of the specified run-off as dictated by FIH.

1.14.3 Pump

The pumps will normally be twin horizontal multi-stage centrifugal units, with 22 kW 400/3/50 2-pole IP55 TEFC electric motors or equal approved. These are started separately by star/delta starters with a full load running current of not more than 45 amps each or equivalent.

Details of the control valve system should be provided at the time of installation.

1.14.4 Control Panel

The control panel will normally be located in the pump house and be designed to accommodate the following features:

- Single button control facility
- Ni cad battery back up
- Non-volatile memory
- The facility to retain data for a minimum of 24hrs in the event of a power failure
- An internal transformer

- The ability to operate station run times in minutes or seconds
- The ability to store STX programmes
- Pump start facility
- Warning signal initiation
- A klaxon should be installed at the control panel location to give an audible warning 30 seconds prior to the operation of the rain guns.
- A suitable remote control system for the pitch side control of the system should be provided.

1.14.5 Storage Tank

The irrigation tank will ideally be located underground and be a GRP construction with a lockable inspection hatch. The tank capacity will be nominal 50m^3, as far as possible without upsetting the stability of the ground. The tank should be a SPEL type tank or equal approved and shall be designed to comply with BS 4994:1987/ISO 976

1.14.6 Water Supply Requirement

It is usual to feed the water storage via an appropriate mains source.

1.14.7 Pipe Selection

All pipes shall have a minimum of 10-bar rating shall be of MDPE construction. Maximum water velocity of 1.5 m/s.

1.14.8 Automatic Dosing System

The tank should, ideally, be fitted with an automatic MPD dosing system. This can be used to deliver a metered dosing of algaecide and moss killer.

2 Section Two: Maintenance

The maintenance of all synthetic turf systems is essential to ensure that the playing characteristics are kept at the appropriate level throughout their lives. Most manufacturers offer warranties of between 5 and 10 years, and many specifiers ask that warranties are performance based ensuring that there are specific measurable performance requirements that should be met through to the end of the warranty.

It is essential therefore that the client ensures that the maintenance regime suggested by the contractor and manufacturer is rigorously adhered to. It is further recommended that the client keeps a log of all operations carried out on the facility, from the frequent brushing to more rigorous deep cleaning usually undertaken by outside contractors. A suitable log can be downloaded from the SAPCA website and used by clients providing they inform the installation contractor and manufacturer of the carpet.

As part of their contractual obligations under the construction design and management regulations 2007, the contractor must supply the client with full details of the required maintenance for all parts of a facility. These details are contained in the maintenance manual which should be provided at completion of the works

This section is meant to be a guide for owners of facilities. However SAPCA recommends that the details of all maintenance carried out on facilities should be that stated by the manufacturer /installer of the synthetic turf.

SAPCA has produced a comprehensive code of practice for the maintenance of all synthetic sports surfaces which covers many of the same principles within this document.

2.1 Introduction

Synthetic turf pitches are fully permeable, and hard-wearing, however to ensure that the surface continues to meet the specific performance requirements throughout the pitches life a degree of maintenance is essential. This maintenance is of vital importance if the surface is to remain good to look at, consistent in play, permeable and long lasting. Indeed, the installers' guarantee will usually be conditional on the recommended maintenance requirements being carried out with reasonable diligence.

2.2 What Maintenance and Why?

Maintenance procedures are designed to ensure that:

- The playing surface is kept scrupulously clean
- The playing surface remains level and of consistent texture so that it gives a true and predictable game
- The free drainage of surface water is maintained throughout the life of the pitch
- The facility looks attractive and well-kept at all times
- Ensure that the specific performance requirements are met

These objectives are achieved by:

- Sweeping leaves and other detritus from the surface
- Grooming the surface through brushing and/or drag matting. Grooming freshens the fibre surface, redistributes evenly any sand or rubber that has been disturbed, and counteracts compaction of the sand and any tendency to form an impervious surface skin that might impair drainage (filled surfaces only)
- Applying prophylactic treatments of moss-killer and/or algaecide
- Power washing to remove algal growth. Extraction is also required to ensure that the residue does not flow back into the carpet (unfilled surfaces only)

Please note: the recommendations of the carpet installer/supplier should always be followed otherwise the manufacturer's warranty may be affected.

2.3 Types of Maintenance

Depending on the type of surface (sand based, sand dressed, 3rd generation or unfilled) the maintenance requirements will differ. Consequently, it is essential to follow the instructions provided by the carpet manufacturer and installer to ensure the correct methodology is applied. In this section a list of maintenance procedures are described which are commonly used for all types of synthetic turf surfaces.

2.3.1 Keeping the Surface Clean

Leaves, tree flowers, pine needles and other detritus should not be allowed to remain on the surface for any length of time. If this does happen, they rapidly rot down forming a drainage-inhibiting 'skin' within the surface and providing a growing-medium for algae and moss.

A wide soft broom or a rubber-tined rake is ideal for removing vegetable matter and other rubbish. Better still, a mechanical leaf-sweeper or vacuum cleaner will greatly speed up the operation. The equipment should be well maintained and carefully operated to avoid contamination of, or physical damage to, the surface. Both sweepers and vacuum cleaners may tend to remove rather too much infill during the first few months of the life of the surface, but thereafter this should cease to be a problem. Some disturbance of the surface including the sand and/or rubber can be a positive benefit (see 'grooming' below).

The provision of litter bins and an information board outlining do's and don'ts will also help to keep the surface clear of rubbish brought on by players and users of the facility. It is strongly recommended that the pitch should be treated as a 'no smoking' area, since a dropped cigarette can melt the fibres down to the surface leaving an unsightly mark. Chewing gum should also be banned.

2.3.2 Grooming

Grooming the surface is a crucial operation if premature deterioration of play characteristics, appearance and drainage properties is to be prevented. Apart from freshening up the look of the surface, the purpose of regular and fairly vigorous brushing is to prevent the formation of a compacted and impervious skin on the top of the sand/rubber bed that will inhibit drainage and encourage moss and algae. Because the bed of infill is an effective filter, it unavoidably retains any particulate matter conveyed or blown on to the pitch or carried down by rainfall. By constantly disturbing and moving the upper layers of sand/rubber, brushing can delay by several years the time when problems of reduced drainage start to develop.

For drag brushing, a wide brush with bristles of medium stiffness is best; the installer should be able to recommend or supply the correct type. There are many types on the market ranging in price from £300 to £1000. On full size installation it would be normal to pull the brush along with a suitable small tractor with low pressure balloon type tyres, these typically cost in the range of £3,500 to £10,000. On smaller installations the brush can be dragged manually. Brushing should ideally be done in both directions each time: up and down the length of the pitch and then at right angles across it, but if this is too time-consuming, the direction of brushing can be varied from occasion to occasion. It will be noted that, following brushing, it is likely that more of the infill will be visible on the surface, so consideration should be given to the timing of brushing if particular users or sports prefer less infill to be visible.

For drag matting, a fine turf steel drag mat may be used (some manufacturers recommend rubber drag mats), but it is essential that no damage has occurred on the meshing of the mat to avoid snagging of the surface. To avoid the risk of damage and slow down the fibrillation (the splitting of the carpet fibres) of the pile, it is known that a carpet ‘sock’ around a steel drag mat can be used. The sock consists of a section of synthetic turf material formed into a sleeve to fit the drag mat. This is used when a light re-distribution of the fill is required, without over agitating the material and bringing it to the surface. If drag matting, with or without a 'sock', is regularly carried out, it is important that a frequent, deeper penetration of the upper infill layers also takes place with a drag brush or, ideally, a powered sweeper, to minimise the risk of a 'skin' or 'pan' forming on the infill layer.

The recommended frequency of grooming must depend on the amount of use the pitch receives and whether its location is open and ‘clean’. Once a week is a recommended norm, but it may be advisable to brush more often if the pitch is heavily used, shaded or subject to pollution.

It cannot be overemphasised that to neglect the grooming of this kind of pitch may have serious long-term consequences even if, in the shorter term, the pitch does not appear to suffer. Grooming need not be either time-consuming or onerous, and its benefits are profound. To omit the process may result in a pitch ceasing to drain at half-life or sooner. An ungroomed pitch will look scruffy and be susceptible to moss infestation.

The installer's advice should always be sought when considering the use of any but the lightest machines.

2.3.3 Power Brushing

Many (but not all) manufacturers of third generation rubber filled surfaces now recommend the use of powered brushing machines for these types of surface to ensure that the rubber particles remain mobile and the carpet fibres upright. Many of the machines on the market utilise a contra-rotating brush, which as the machine moves forward brushes the fibres and particles forward. The equipment required can cost in the range of £3,000 to £15,000 and is a worthwhile investment for facilities which are heavily used or are required to be in their best condition at all times. If this is beyond the capability of owners of small facilities then there are specialist contractors offering this service at around £300 to £500 per visit. The process may be required up to four times per year but will depend upon usage and environment.

2.3.4 Deep Cleaning

If, in spite of the regular maintenance described above, or as a result of a lack of it, the surface becomes over-compacted and impervious, this condition can often be corrected by appropriate treatment usually involving the use of specialist machinery. Machines vary from simple scarifiers to more elaborate proprietary machines that remove a proportion of the infill (containing almost all the filtered dirt) from the upper part of the carpet. This is then replaced with new (or cleaned) infill. The best of these processes will improve the play characteristics, ball roll and surface/foot interaction and will prolong the useful life of the pitch by a number of years. It is essential that any scarification or very deep penetration of the surface is only carried out by experienced operatives.

Power washing of filled surfaces should be avoided as the action of the water on the fill can mix the contaminants through the depth of the pile and increase clogging of the through drainage.

Both sand filled/dressed and rubber filled surface may in time require a degree of deep cleaning. The timing required for these actions will depend largely upon the environment and usage. Detritus, pollution and the breakdown of the carpet fibre all add to surface contamination. In time these will settle into the carpet pile and lead to hardening of the surface and a reduction in surface permeability. Usually an owner of a facility will only be aware of the need to carry out deep cleaning when the surface begins to hold water after heavy rain. The amount and type of deep cleaning required will depend upon the type of surface contamination and how far down into the carpet pile it has reached. It may be worthwhile employing a specialist to assess this and recommend the most appropriate corrective action. There are two basic methods which will remove contamination from within the carpet fibres.

The first uses a large contra-rotating brush to brush out around 5 mm of the infill material and help to brush up the carpet fibre, the contaminated sand/rubber is vacuumed out and in some cases filtered and returned to the surface, in others it is simply returned to the surface, and if required can be removed and replaced. Typical machines necessary to undertake this type of cleaning cost around £15,000. However there are a number of specialist companies offering this service at around £3000 for a full size pitch. This process is unlikely to be required within the first five years of the pitch's life unless flooding or other serious contamination event has occurred. However consideration should be given to carrying out this every 2 or 3 years after the end of the first five years. It has been noted however that if contaminated infill is not removed from the pitch it can prove to be a continuing problem gradually settling out further down into the carpet fibre.

The second method of deep cleaning uses proprietary machines which use either compressed air or water to force the contaminated in-fill from the carpet fibres, which is then removed from the surface filtered and returned or new infill is installed. Generally these machines remove up to 15mm of contaminated fill material. The cost of these treatments can be around £30,000 for a full size pitch and should be considered if severe contamination has occurred and the pitch surface permeability has reduced to a degree where the pitch not being used after heavy rain due to surface water or the contamination, usually in the form of a slippery sludgy material, is causing the pitch to be dangerous from the point of view of players slipping over.

2.3.5 Moss and Algae Prevention and Removal

In certain situations and in some seasons algae or moss can become established on the surface. Since prevention is very much more effective than cure, it is important to treat the affected areas of the pitch with a good proprietary mosskiller and algaecide at least once a year. Some manufacturers will recommend twice a year as they are known to have minimal residual properties.

Moss is not usually found on the parts of the surface that are trafficked by play, and although it may not be essential to treat these areas it is still a wise precaution to do so. However, particular attention should be paid to perimeter and other areas that are not trafficked, especially if they are shaded by walls or buildings or are overhung by trees. Any good proprietary product should be satisfactory provided that it is not oil-based. The manufacturer's instructions should be closely followed. Some installers can supply specially formulated moss-killers.

Where moss becomes established it should be treated immediately, the application being repeated after the dead spores are removed until eradication is complete. In the case of very severe infestation, the installer should be consulted. High air-pressure cleaning equipment is available but its use is a skilled process.

It should be emphasised that moss is only a serious problem if it is allowed to become established. An annual prophylactic application of moss-killer is an easy way of preventing this. Regular grooming and regular use of the pitch render moss an even less likely problem.

2.3.6 Removal of Weeds

No matter how much care is taken, weeds may occasionally appear on the surface, usually as a result of wind-blown seeds. Small numbers of weeds can be removed by hand without damaging the surface. If the weeds are removed by hand, it is important to ensure that the full root of the weed is extracted, not broken off. Some weeds are more prolific if they are simply cut off at surface level. If the weeds are deep-rooted it is advisable to kill them off with an appropriate weed-killer.

Localised areas of weed seedling infestation can be treated with domestic weed killers without causing damage to the surface of the pitch. You should always check with the carpet supplier/installer to ensure the chemicals applied to the surface are acceptable and will not void the warranty. Oil-based weed-killers should not be used.

2.3.7 Play Lines

A synthetic turf pitch will normally be supplied with permanently inlaid play lines. The number of sports to be included and whether the lines are to be inlaid or painted on to the surface will be decided prior to construction. However, if additional lines are required for special events or changes in the sports being played, these can be painted onto the surface using proprietary line paint. Some of these are more effective than others and consultation with installers, suppliers and other users of synthetic turf pitches is recommended. Chalk lines can be applied but these tend to leave a lasting powder spread in the area of the line. Marking compounds for natural grass should not be used as these will leave a build-up forming a crust and potential trip hazard.

Permanent lines require no special attention, other than; if cut-in, occasionally checking they are secure. This regular check should also be carried out on the seams in the carpet. Any

breakdown of the seams at lines or in the main carpet should receive immediate attention to avoid on-going deterioration. This should be reported to the installer if within the warranty period. If the warranty has expired, a number of specialist companies will offer seam repair services.

2.3.8 Stain Removal

Most stains can be removed easily with a solution of hot (not boiling) water and a household detergent such as washing-up liquid. The removal of chewing gum can be simplified by making the gum brittle with a proprietary aerosol freezing material. Heavy oil marks can be removed with a cloth and white spirit used in moderation.

2.3.9 Snow and Ice

Snow and ice are not harmful and can be permitted to melt through. If it is important to remove the snow to enable play to start sooner than would otherwise be the case, brushes or wooden scrapers may be used. Metal shovels or scrapers may damage the surface and should not be permitted. Rock salt and chemical de-icing agents should not be used. In certain cases vacuum-dried salt or urea have been used as effective preventatives when applied in advance of the weather deteriorating.

Provided that the foothold is adequate the pitch may be played on when frozen, but heavy use is to be discouraged because the fibre is relatively brittle at low temperatures. The degree of shock absorption will also be substantially reduced and players should be made aware of this fact. Health and Safety should be a primary consideration and a risk assessment should be carried out.

If heavy rain fails immediately after a very cold spell, the pitch may become flooded for a few hours. The same thing can happen when snow or heavy frost starts to thaw. This is because the infill beneath is still frozen, but should not be a cause for concern, as the remaining ice will soon melt and the surface will then drain normally.

2.3.10 Footwear

Suitable footwear should always be used. Most shoe manufacturers produce a boot which is specifically designed for the sport played on a synthetic turf pitch. Some synthetic turf systems, e.g. long pile systems, are designed to take a normal soccer or rugby stud. Particular attention should be given to bladed studs, it has been suggested that these types of studs can increase wear on the surface. Consequently, if any doubt exists the surface manufacturer should be consulted.

2.3.11 Initial Maintenance (Filled Surfaces)

For infilled surfaces immediately after installation of the carpet there may be a period where the infill is somewhat mobile and has not reached the full degree of compaction within the carpet pile to give its optimum performance.

Initially the surface may have a slight excess of in-fill material on its surface, but full penetration of the infill into the fibres of the carpet and its subsequent compaction into a uniform playing surface occurs naturally, through good initial grooming helped by rainfall and by play on the surface. This process may take up to two to three months. It may be necessary to top up specific areas of high wear such as penalty spots, short-corner areas etc. at regular intervals dependent on usage.

During construction every effort is made to ensure even distribution of infill over the whole pitch. Experience shows, however, that increasing the frequency of brushing in the early weeks of use is beneficial in creating the final playing surface.

If areas are found which are short of infill, it should be possible to brush the infill into them from adjacent areas of ample or surplus material, provided this is done within the first few weeks. If the under-filled areas are extensive (or do not respond to this treatment) the installer should be called in immediately to add more infill.

2.4 Typical Maintenance Schedule

The following are minimum recommendations. Cleaning, brushing and pitch inspection can always be done more frequently, to the benefit of the surface. Common sense and careful observation should prevail. If any serious doubt exists about the effectiveness of the maintenance regime or the condition of the pitch, call in the installer immediately.

Daily - at end of the days play:

- Check fixtures and fittings
- Make sure gates are shut
- Check and top-up fill levels at penalty spots, short corners, etc. (filled only)

Weekly:

- Clear leaves and rubbish from the area
- Deal with any new weeds, moss or algae
- Brush the surface of the pitch

Monthly:

- Check infill levels (filled only)
- Outside the fence, check and clear mowing strips and check cleanliness of access paths
- Check seams, inlaid lines, etc., and report failures to installer
- Check the irrigation system (if required)

Periodically - at least every six months:

- Check thoroughly for moss and algae growth, food stains, etc, and remedy as appropriate
- Treat pitch with moss killer, algaecide, etc.
- Power brushing to help keep the infill mobile and the carpet fibres erect (filled only)

Annually:

- Treat pitch with moss-killer/algaecide
- Call in installer if any aspect is causing significant concern

Deep cleaning should only be carried out if surface contamination is suspected and then only by specialist contractors.

3 Section Three: Resurfacing

3.1 General Considerations

When consideration is being given to resurfacing an existing pitch that has a synthetic turf carpet of some type, it should be recognised that the requirements of the client, the sports' governing bodies, British Standards, the local authority, etc… may have changed considerably in the years since the pitch was originally constructed. In addition, the technology of synthetic turf systems is constantly moving on and will have advanced significantly since the first installation. In the absence of a copy of the original design and specification, it is essential that a comprehensive investigation be carried out to establish the basis of the original design and its relevance to the design being proposed for the resurfaced facility.

3.2 Design Considerations

3.2.1 Playing Characteristics

Different sports require different playing characteristics and their respective governing bodies stipulate precise requirements. It may be that the sport to be given priority on the resurfaced pitch is different from on the original pitch, or that the requirements of the sports' governing body have been amended since the original pitch was constructed. In any case, the design considerations detailed in Section 1.1 of this document should, where possible, be followed.

Where it is not possible or practical to comply with these requirements, this fact must be pointed out to the client prior to commencement of re-construction works.

3.2.2 Dealing with the Existing Surface

The most common reason for resurfacing an existing facility is that the playing surface is no longer suitable for the standard of play required from the pitch. It follows that this surface must be removed and disposed of prior to any reconstruction works taking place. This removal process must be undertaken in a manner that will not damage the existing structure below the playing surface. These layers may include a shockpad, unbound layers, geotextile membranes and macadam bases. Subsoil drains may also exist at a depth which could make them vulnerable to damage by heavy vehicular traffic.

The existing surface, and perhaps the shockpad, must be disposed of off-site and careful thought should be given to environmental considerations when disposing of this material. In the case of hard porous materials such as redgra, olisett, blaes and similar this will not normally present a problem in landfill sites. However, the disposal and handling of synthetic turf carpets, silica sand fill, rubber fill and rubber shockpads may present problems in certain areas and will carry a price premium on disposal. In some instances recycling companies will collect the unwanted materials at a lower cost than land fill disposal. Additionally, depending on its condition the synthetic carpet could be sold to another user.

3.2.3 Dealing with the Existing Shockpad and Base

Until the entire surface layer has been removed from an existing pitch, it is very difficult to be confident of the condition of the layers below. Cores or cross-sectional samples can be taken but this can only provide an indication of the condition of the substructure layers.

On removal of the surface the remaining layers of the existing construction should be checked as to their suitability for incorporation into the new construction.

3.2.3.1 Shockpad

If the existing pitch was constructed using a shock-pad (see Section 1.8) as a resilient layer to provide player comfort and to comply with the playing requirements for various sports, this existing pad must be checked to ensure that it will perform satisfactorily in the new design. This may require performance testing of the combined pad and new surface system by an approved test house before reconstruction begins.

The condition of the existing resilient layer is likely to vary over the area of the pitch and care must be taken to ensure that any inspection/survey is comprehensive.

Experience has shown that prefabricated shock-pads that are not either stuck down to the base or seamed together have a tendency to move under the carpet. If the existing pad is found to be otherwise satisfactory, the contractor should ensure that it is either stuck down to the base or seamed using an acceptable tape before re-use.

During a resurfacing process it may be necessary to carry out regulating works to either a macadam or stone type base. Where pre-fabricated shockpads have been used it has been found to be very difficult to roll up and re-use the rolls of shockpad and it may be necessary to dispose of them and to install a new shockpad.

If specific areas of shock-pad are found to be unsuitable it is permissible to reinstate these areas with a pad of equal thickness, resilience and density or as near as can be reasonably achieved.

If doubt remains about the suitability of an existing pad, it should not be incorporated in the new surface system but should be removed from site and a new shock-pad installed.

3.2.3.2 Unbound Layers

Where the existing pitch has been constructed using an unbound base of loose rock or sand (see Section 1.7.2) and it is the intention to retain this design in the new facility, the top layer of the unbound construction may need to be regulated to level using new material and then re-compacted to specification. The amount of re-levelling or compacting will depend on the mobility of the existing un-bound material; the amount of disturbance, if any, caused by the removal of the surface layers, along with the degree of protection the upper geotextile layers have given the structure during its life. This course of action will also apply where lava/rubber mixes (see Section 1.7.3) have been used in the existing facility and it is the intention to continue with this form of resilient layer.

If the design of the new pitch is to incorporate a bound base, i.e. using one or two layers of bituminous macadam with a shockpad as a resilient layer, the material which constituted the unbound layers, which may be frost susceptible and impede drainage, should be removed down to the dry stone sub-base layer.

3.2.3.3 Bound Base

If the existing pitch has been constructed with a bound base of one or more layers of bituminous macadam on a dry stone sub-base layer (see Section 1.7.1), the client should be

given the option of adding a further layer of macadam if the initial pitch was constructed using a single layer.

The porosity of the exposed macadam base should be checked by an appropriate method, e.g. flooding the pitch to check for impervious areas which may then be drilled to improve the flow of surface water through the system. All drill holes should be filled with pea gravel and consolidated prior to installation of subsequent layers.

The final surface level tolerance referred to in Section 1.1.4 will be difficult to achieve unless the top surface of the macadam base is also laid to this tolerance. Careful checks on the surface of any previously laid macadam should be carried out to ensure compliance.

3.2.3.4 Sub-base

The sub-base must comply with the requirements of Section 1.5.

Checks, by excavating trial holes, should be made to ensure adequate thickness of sub-base material and that the material has not become contaminated in any way, e.g. from the migration of fines from an overlying unbound base.

3.2.4 Drainage

The existing drainage system should be checked for compliance with Section 1.4. It may be necessary to 'prove' the existing drains by rodding or carrying out a standard drain test. The presence of silt collection chambers should be checked along with the presence of rodding eyes. Resurfacing the pitch may be seen as an opportunity to install such facilities where they do not exist in adequate numbers

Any soakaways should be checked for efficiency of operation and opportunity taken to connect to surface water outlets, if now available, as alternatives to soakaways.

3.2.5 Perimeter Edging

The existing edging which retains the pitch construction should be checked for line and level as well as structural integrity of the materials, including the backing. Any areas that do not comply with the requirements of Section 1.6 should be rectified prior to installation of the new facility. This may mean total replacement of the perimeter edging, particularly where the finished level is going to vary substantially from the original profile.

3.2.6 New Surface

The design and specification of the new synthetic turf surface should comply with the requirements of Section 1.9.

3.2.7 Fittings

All existing fitted equipment, including inset sockets etc, should be checked and replaced where required as part of the contract for the new pitch facility (see Section 1.10).

3.2.8 Surround Fencing

As part of the upgrading programme, the surround fencing should be inspected and repaired or replaced, as required, in accordance with Section 1.11.

Appendix A – Maintenance Log

Client Maintenance				
Date & Time	Type of Maintenance (e.g. Brushing, Sweeping, Inspection)	Undertaken By:	Checked By:	Comments
Page X		Checked by:		Date:
Once completed add this sheet to the main file				

External Maintenance				
Date(s) & Time	Description of Maintenance	Undertaken by (Company & Name)	Checked by (Client)	Comments

Page X	Checked by:	Date:
Once completed add this sheet to the main file		