SAPCA

SPORTS AND PLAY CONSTRUCTION ASSOCIATION

The SAPCA Code of Practice for the Construction of Outdoor Multi Use Games Areas

www.sapca.org.uk

The Sports and Play Construction Association

September 2021, (1st Edition)

ISBN: 978-1-907391-11-8

The Sports and Play Construction Association
The Hexangle
Stoneleigh Park
Warwickshire
CV8 2LG.

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Preamble

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 an Outdoor Multi-Use Games Area (MUGA).

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 SAPCA Members of the MUGA Division or Professional Services Division be engaged to provide the necessary level of expertise in the design and construction sports facilities, ensuring compliance with the current legislation. In the case of Outdoor Multi-Use Games Areas, where the appropriate choice of surfacing for the intended usage is vital to the success of any project, professional advice from experienced contractors and consultants is essential.

Notes to be read in conjunction with the Code of Practice.

- This Code of Practice is intended for use by organisations considering the construction of a Multi-Use Games Area, architects and consultants designing and specifying such facilities and sports surfacing contractors building them. The Code of Practice should not be used as a substitute for carrying out appropriate surveys and obtaining professional advice in individual circumstances. Although the Code of Practice has been produced by reference to MUGAs 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 howsoever caused arising from reliance on the specifications within the Code of Practice.

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

- Parties not experienced in synthetic sports surfacing construction are strongly advised to consult qualified contractors and/or sports construction consultants. The Sports and Play Construction Association can provide details of experienced contractors and consultants, within the MUGA, Pitch, Track and Tennis Division and Professional Services Group.

- The term “asphalt” is the internationally accepted technical term for all surfaces which are composed of a mixture of bitumen and stone.

- In accordance with common practice within the construction industry, 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 MUGA, within the applicable tolerances’ margins.

- In the interests of clarity and consistency, the minimum compacted depth is also specified, to define the tolerance on the design depth that is considered acceptable. It is intended that the consistent use together of the terms “nominal compacted depth” and “minimum compacted depth”, by contractors and consultants alike, will help to avoid any confusion when competitive quotations are being examined.

- The information contained within the Code of Practice, while accurate at the time of publication, may be subject to change at a future date. Due to changing technologies and new developments in construction methods, revisions to the recommendations are likely and only the most recent edition of the Code of Practice should be used.

- SAPCA will keep under review the use of the Code of Practice and will consider any suggestions for amendment, which should be addressed to the Chief Executive, The Sports and Play Construction Association, The Hexangle, Stoneleigh Park, Warwickshire, CV8 2LG. Revision to the Code of Practice will be made when such action is considered appropriate.

- 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 Multi-Use Games

Area 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) Regulations 2015, require that a CDM coordinator be employed by the client during the design, specification, tendering and construction of any construction project that is likely to involve more than 30 working days or 500 person days. 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.

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, ensuring provision of 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.

The SAPCA website (www.sapca.org.uk) provides a wealth of valuable information for anyone involved in the development of sports facilities.

Further information

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

SAPCA
SPORTS AND PLAY CONSTRUCTION ASSOCIATION

The Sports and Play Construction Association
The Hexangle
Stoneleigh Park
Warwickshire
CV8 2LG

Telephone: 024 7641 6316
E-mail: info@sapca.org.uk
Web: www.sapca.org.uk

1 List of Tables

Definitions and existing standards of reference

BS EN 14877 (2006) “Surfaces for Sports Areas – Specifications for Synthetic Surfaces (multi-use)”

BS EN 15330-1 (2013) “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”

SAPCA Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches 2009. (available at https://sapca.org.uk/guide/codes-of-practice).

SAPCA Code of Practice for the Construction and Maintenance of Tennis Courts April 2018. (available at https://sapca.org.uk/guide/codes-of-practice).

Sport England Design Guidance Note ‘Artificial Surfaces for Outdoor Sport’ Dec 2013.

England Netball – Netball Performance Standards for Outdoor Courts (Class 3 and 4).

FIFA Quality Programme - Handbook of Requirements for Football Turf October 2015.

International Hockey Federation (FIH) – FIH Quality Programme for Hockey Turf.

World Rugby (WR) - Rugby Turf Performance Specification

Rugby Football League (RFL) - Performance and Construction Standards for Synthetic Turf Pitches (2018)

Introduction

From the first considerations regarding the construction of a Multi-Use Games Area through to 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.

- Section one defines what a MUGA is, the different surface types and how the surface types are compatible with different sports.
- Section two details the general construction requirements for MUGAs and offers design guidance and minimum standards for construction.
- Section three considers the maintenance and management of facilities once they are in use.
- Section four details a checklist to consider when planning, designing, and constructing a MUGA.

Table 1 Construction of a Multi Use Games Area

Project Brief	This phase reviews the project brief and considers factors such as location, usage, funding, procurement, and project management.
Project feasibility	This phase can include the development of a business plan, planning application and if required funding applications. A consultant can be appointed during this phase if required, this will normally be for a large project.
Site investigation	Prior to the design phase a detailed site investigation is required. This includes topographical, geotechnical, electrical and drainage surveys. This may not all be necessary on a small project.
Design specification	This phase includes the production of full design specifications and technical drawings.
Appointment of contractor	In this phase a review of submissions is undertaken. This includes evaluation and contractor selection.
Construction period	This phase includes the construction of the facility. If required, independent quality control is undertaken to assess build quality and design specification conformity.
Project completion	This phase includes handover of the completed project. If required, performance testing may be undertaken to ensure compliance. A maintenance regime should be provided by the installer.

2 Section One – What is a MUGA

2.1 Introduction

Multi Use Games Areas (MUGAs) offer a cost-effective solution for communities, schools and other facility providers faced with a wide range of sporting demands and limited space or budgets. When correctly designed they can provide an asset that enhances the local sport and physical activity provision. Whilst a MUGA area is often seen as a "safe option", it must be recognised that there will almost always be a need to compromise, primarily in terms of dimensions and the performance of the playing surface to accommodate the sports for which it is proposed. There are also widely differing requirements for the playing surfaces for various sports and many different needs for individual facilities. It is not possible to provide a simple solution or formula that will satisfy every situation. Each facility must be carefully planned according to specific demands and priorities.

The guidance in this document is intended to raise a number of important issues, which, if carefully considered and addressed, should help to produce the most suitable design. The advice detailed is based on many years' experience from contractors, designers, users of MUGAs and sport's governing bodies.

Whilst there are many ways of designing, constructing, and surfacing a MUGA these guidelines describe the systems most commonly used and found to provide the playing qualities and experience those users require, whilst at the same time providing a safe and durable environment.

Critical to the success of any sports facility is an initial assessment of the likely use of the facility, and the ability of a location to meet the strategic and local sport's needs. It must be determined which sports the facility will provide for, the standards of playing performance needed, and the priorities for usage between them. The choice of sports, and the feasible balance between them, may also depend on the different levels of income generation that are possible. The initial planning stage should also include a thorough assessment of the proposed management and operation of the new facility.

In many ways the construction and performance of a synthetic turf MUGA is similar to a full-size synthetic turf pitch, but there are differences. These primarily relate to the design of the drainage and foundation layers and the types of fencing and floodlighting used. As a rule, any facility surfaced with porous asphalt or polymeric surfacing is considered to be a MUGA, as are synthetic turf areas of less than 3000 m2. If you are considering a synthetic turf pitch with an area greater than 3000 m2 it is strongly recommended you refer to the 'SAPCA *Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches*' which is available within the Technical Guidance section on the SAPCA website. Click here

This document outlines the needs and requirements for MUGAs designed and used primarily for traditional sports like tennis, netball, basketball, football (including small-sided and walking football and futsal) and field hockey. Consideration should also be given in MUGA design to non-traditional activity areas where access to the facility is often open and the surface is not always one dealt with by this document. Further information on these types of facilities can be found in SAPCA's MUGA guidance.

2.2 The choice of MUGA

It is important at the briefing and design stages of a MUGA development to consider issues that might have a direct impact on the installation and operation. Critical consideration should be given to:

- The predominant sporting use for the MUGA.
- The degree of intensity of use and the potential age profile of the users.
- The sports performance and playability characteristics required.
- The intended maintained lifespan.
- The sinking fund requirements (including full economic cost considerations).

The most commonly played sports on multi-sports games areas are tennis, netball, basketball, football (including small-sided and walking football and futsal) and hockey. Other sports that might also be played include rugby training, rounders, athletics training, volleyball, and other recreational physical activity.

The need for a facility to compromise arises mainly due to the choice of the principle sports' playing performance requirements, as certain surface types are more suitable than others for different sports. The interactions between the player and surface and the interactions between the ball and surface also need to be considered to ensure a suitable playing surface for the intended sport.

One of the important issues relating to the choice of surface is the need for some form of shock absorbency (or cushioning), for which there can be conflicting requirements between the sports. On the one hand there are clear benefits for participants in protection from injury, but too much cushioning may be detrimental to the performance of ball rebound in certain sports, such as tennis, basketball, netball, and football.

Other sports, especially netball, and to a lesser degree tennis, require high levels of grip from the surface to enable the sports to be played to a satisfactory level. Not only do these high levels of grip often require specialist finishes to the playing surface, but the ability of surfaces to retain the high grip is greatly influenced by the other sports played on the MUGA and the types of footwear worn.

It is possible to quantify the playing performance of sports surfaces, using a series of standard test methods to measure the different characteristics. Many sports governing bodies can also provide guidance on the individual recommendations for their own sport.

The term Multi Use Games Area (MUGA) implies several sports are to be played in one area. It is important at the design stage to consider which is the priority sport and what performance characteristics of the secondary sports can be compromised in the choice of the playing surface.

2.3 Existing guidance and standards

This Code of Practice provides an introduction to the design and construction of outdoor multi-use games areas. Reference should be made, as appropriate, to other relevant sources of information, including British and European technical standards, other SAPCA Codes of Practice,

Sport England's Technical Guidance Notes, and relevant technical requirements for the performance of playing facilities produced by individual national and international governing bodies of sport.

Different sports require separate playing characteristics, and their respective governing bodies stipulate precise requirements. Choosing a priority sport may mean that certain playing characteristics are not ideal for, or even not compatible with, other sports.

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 intended users of the facility. The aim is to ensure that professional level pitches are not being specified for facilities where recreational standard use is adequate and often more cost effective.

Various types of MUGA's 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.

Appendix A – details typical performance requirements for the ten types of MUGAs detailed in this Code of Practice.

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

When completed the client may require the facility to be tested by an independent specialist test house, to the relevant performance standard to ensure compliance with the performance and safety criteria specified.

2.4 Types of MUGA surfacing

For reference, MUGAs can be classified into numerical groups based on their design. Whilst this helps to procure a MUGA, it should be noted that as sports surface technology advances manufacturers and contractors are increasingly able to design MUGAs that can be used for a range of applications. Manufacturers can develop bespoke proprietary systems which will provide performance criteria which are suited to a specific application or sport(s) or indeed designed to meet the requirements of several sports. Therefore, it is recommended research is undertaken to evaluate the most suitable system for your sporting requirements.

Historically MUGAs surfaces had been split into five categories. In this document the classification has been expanded to reflect the technological developments in sports surfacing that has increased the range of surfaces now being used.

Type 1 - Open textured porous asphalt areas (possibly painted) Designed for ball rebound sports where tennis is the priority and sports such as mini-tennis, basketball and netball are secondary users. These areas are also suitable for wheelchair sports although care is needed in warm weather during the first year of use or subsequent years when temperatures in excess of 20ºC are experienced.

Type 2 – High grip open textured porous asphalt areas (possibly painted)

Designed for ball rebound sports where netball is the priority and sports such as tennis, mini-tennis, and basketball are secondary users. These areas are also suitable for wheelchair sports although care is needed in warm weather during the first year of use.

Type 3 – High grip finish polymeric surfaces

Designed for ball rebound sports where netball is the priority and sports such as tennis, mini-tennis, and basketball are secondary. These areas are suitable for wheelchair sports.

Type 4 - Polymeric surfaces

Designed for football, basketball and sports and recreational training and physical activity. Due to their greater shock absorbency and lower surface friction these areas are not recommended for tennis or netball.

Type 5 – Sand filled synthetic turf areas with a shockpad

Designed for sports such as hockey and small-sided football and may also be used for non-contact training for rugby union, rugby league, American Football and other activities.

Type 6 – Sand filled synthetic turf without a shockpad

Designed primarily for tennis. Whilst they can also be used for sports such as hockey and football, their relative lack of shock absorption does mean they will not comply with the relevant British Standards and sport's governing body recommendations.

Type 7 – Sand dress synthetic turf areas with a shockpad

Designed primarily for hockey, these surfaces can also be used for other sports such as netball, tennis, small-sided football and may also be used for non-contact training for rugby union, rugby league, American Football, and other activities.

Type 8 – Third generation (long pile) synthetic turf

Designed to replicate the playing characteristics of natural grass, this type of surfacing is currently the preferred choice of the FA, RFU and GAA for all forms of football and rugby (with a shockpad). They are also used for American Football and lacrosse. Recreational hockey can also be played; however, the surfaces are not suitable for tennis, netball, or basketball.

Type 9 – Needle-punch carpets

This type of surface may be sand filled and sometimes bonded to the sub-base. It can be laid with or without a shockpad and depending on the type selected are considered suitable for tennis, netball, hockey, and football.

Type 10 – Non filled synthetic turf

This type of surface comprises stitched or woven yarn without any infill. Historically popular as a hockey surface (water based) non filled turfs are now being designed for other sports such as football and rugby.

Table 2 Principal playing surfaces verses sports suitability

Sports Surface	MUGA Type	Tennis	Netball	Football	Basket-ball	Hockey	Rugby Training	Athletics Training
Porous asphalt - standard grip	**1**	1	3	4	2	4	4	4
Porous asphalt - high grip finish	**2**	2	1	4	2	4	4	4
Polymeric - high grip finish	**3**	2	1	3	2	3	3 (non-contact)	2
Polymeric - standard grip	**4**	2	3	2	2	3	3 (non-contact)	2
Sand filled synthetic turf with shockpad	**5**	3	4	3	3	1	3 (non-contact)	3 (excluding spikes)
Sand filled synthetic turf without shockpad	**6**	1	3	4	3	3	4	3
Sand dressed synthetic turf with shockpad	**7**	2	2	4	3	1	3 (non-contact)	3 (excluding spikes)
3G synthetic turf	**8**	4	4	1	4	3	1	3
Needle- punch synthetic with shockpad	**9**	2	2	3	3	2	3 (non-contact)	3 (excluding spikes)
Non filled synthetic turf	**10**	3	3	2	4	1	2	4

1 = preferred surface	2 = suitable surface	3 = possible surface although not recommended by sports governing bodies	4 = considered unsuitable

2.4.1 Asphalt surfaces (Type 1 and 2)

Asphalt surfaces may take the form of dense or porous asphalt. Whilst the former may provide a more durable surface and is typically laid on school playgrounds and car parks, its inability to drain is a major constraint on sports use (a well-maintained porous asphalt can be played on in most weather conditions year-round, with the exception of when the surface is covered in snow). Therefore, a porous asphalt is considered more suitable and is used on around 90% of all asphalt MUGAs and tennis courts in the UK.

Porous asphalt MUGAs may be colour coated to improve aesthetics and the playing environment. This is achieved by either using pigmented materials to form the porous asphalt or by painting the un-pigmented surface after installation. Although the cost of pigmented porous asphalt may be initially higher the increased durability of the colour may make it more suitable for areas of high use.

The demands of netball for a high grip surface make the choice of the porous asphalt surface finish critical whenever this sport is to be played. The ability of painted surface to retain acceptable levels of grip for a reasonable period of time is questionable whenever the area is used for activities that may abrade the high grip finish (such as playing football). In such cases experience has shown the use of a hard angular aggregate (granite) to form the porous asphalt surface is a better way of ensuring a durable surface is provided.

2.4.2 Polymeric surfaces (Types 3 and 4)

Normally formed from a mixture of polymeric binder and rubber granules either as prefabricated rolls or laid in-situ with a mini-paving machine, polymeric surfaces have a degree of inherent shock absorption.

To provide the high degree of slip resistance required by sports such as tennis and netball a specially modified final coating can be applied to the surface, although the use of this surface for ball contact sports will cause a rapid reduction in its slip resistance. Consequently, combining sports such as five-a-side football and netball is not recommended.

Some forms of thicker polymeric surfacing are also capable of taking a running shoe spike.

To ensure the surfacing has acceptable durability and resistance to weathering all forms of polymeric surfacing should satisfy the laboratory and if required, field test requirements of BS EN 14877 (2013 edition).

2.4.3 Synthetic turf surfaces (Types 5 – 8 and 10)

The definition of a synthetic turf is ‘a sports surface comprised of a carpet of tufted, knitted, woven, needle punched or fibre bonded construction whose pile is designed to replicate the appearance and behaviour of natural grass. With pile heights ranging from 10mm (tennis) to 60mm (football and rugby) there are many different types of synthetic turf with a range of properties, and advantages and disadvantages. Variables include the polymer used for the fibre yarn (such as polyethylene and polypropylene), the cross-sectional area of the individual ribbons of fibre, the method of carpet manufacture, pile height, pile density and choice of infill.

Historically, the majority of MUGAs have been surfaced with tufted sand filled carpets. Experience has shown this form of carpet to have good durability and performance when used in the extreme wear conditions, which are often experienced on MUGAs. The development of longer pile (3G) surfaces has, however, increasingly seen these types of surfaces being used when football or rugby are the principal sport.

Irrespective of which type of synthetic turf is selected to ensure the surfacing has acceptable durability and resistance to weathering all forms should satisfy the laboratory and if required field test requirements of BS EN 15330-1 (2013 edition). Depending on the sports being played on the MUGA, some facilities may also need to comply with sports’ governing bodies standards such as the FIH performance standard for Hockey5s.

Non-filled (often called water-based)

The original (or first generation) form of synthetic turf; these surfaces are manufactured with a short dense pile. Now primarily used for top-level hockey most unfilled products require the use of water to provide acceptable levels of foot grip (considered too high when dry). They are now often referred to as `wet fields` or `water-based`. 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. As a hockey specific product this type of surface would not be suitable as a MUGA.

New technologies are now seeing the development of non-filled surfaces which are not designed to be used after the application of water. The surfaces which will potentially be designed for playing a combination of football, rugby, hockey, netball and tennis could be considered suitable for a MUGA.

Sand-filled

The second generation of synthetic turf has a longer (typically 18 - 25mm) and more open pile structure than non-filled surfaces. This allows the carpet pile to be in filled with sand and provides a durable, cost-effective surface that can be used for a number of sports at a reasonable level of play. There are also shorter pile products made specifically for tennis (typically 10 – 15mm) with a denser pile structure and less sand infill.

Most carpets are tufted from polyethylene, polypropylene or mixed co-polymer yarns and are infilled with a non-abrasive, well-rounded silica sand, that is dust-free and of uniform grading and density. The sand infill is normally to within 2-3 mm of the fibre tips. As the sand and fibre combine to provide the characteristics of the playing surface it is essential that the level of sand fill is maintained throughout the life of the facility.

Sand-dressed

A derivative of the sand-filled system are ‘sand-dressed’ carpets. These are carpets with a shorter, denser pile than the standard filled grass systems with a reduced quantity of sand fill. Sand-dressed systems are commonly specified as alternatives to the water based for hockey.

Long pile - third Generation (3G)

The ‘third generation’ system of synthetic turf has been designed to replicate natural pitches used for football and rugby and has become popular with the governing bodies of both sports and have been approved for football and rugby at the highest level (see FIFA and World Rugby requirements).

Surfaces falling into this category differ from standard sand-filled systems in the height of pile, commonly from 40mm up to 60mm, and the level of infill, normally 2/3 of the pile height. The infill to the 3G system is normally designed to provide all of the shock absorbing properties (when a shockpad is not incorporated into the surfacing system) and comprises granules that are incorporated with sand in layers to provide the required stability and performance

Due to concerns surrounding the loss of this infill material into the surrounding environment during a combination of usage and maintenance there have been calls for improvement in pitch designs to prevent this loss of infill. The European Standards Committee (CEN) has produced a Technical Report on ‘Guidance on how to Minimise Infill Dispersion into the Environment’ (2020).

It is important that the designs to minimise infill dispersion are incorporated into the overall design to the synthetic surfaced MUGA. SAPCA developed a *Code of Practice for the Selection and Use of Sports Performance Infills in 3G Artificial Turf* (published in February 2021) to ensure that the design and construction of facilities with 3G surfaces are carried out in accordance with this guidance. It is essential when designing a MUGA that this guidance is adopted to prevent the loss of infill from the pitch to the surrounding environment.

2.4.4 Needle-punch (Type 9)

Needle-punch carpets have been used as a multi-use surface for a considerable time as they provide an alternative to sand filled / dressed synthetic turf surfaces and offer good playing characteristics and durability. They normally range from 8mm-16 mm in thickness and have a sand filling applied after installation. Some systems are bonded to the porous asphalt base and others are loose laid.

To ensure that any of these types of synthetic surfacing has acceptable durability and resistance to weathering, the products should satisfy the laboratory and if applicable, field test requirements of BS EN 15330-2.

2.4.5 Shockpads

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

To ensure that the shockpad has acceptable durability and resistance to weathering, the product should satisfy the laboratory test requirements of prEN 15330-4 and the shockpad guide, published by the European Synthetic Turf Council.

2.4.5.1 Prefabricated construction

The type and thickness of the shockpad will be dictated by the priority sport, although several different options may be able to provide a surface system that complies with playing characteristic requirements. Normally supplied as flat rolls or as inter-locking tiles these types of shockpad generally have a thickness in the range 10 - 23 mm.

Whichever shockpad system is installed, a reference sample should be obtained at tender negotiating stage so that the installed shockpad can be checked for consistency of material. The shockpad installed should be done in accordance with the manufacturer’s instructions.

Each type of shockpad has different features and benefits which the manufacturer will confirm and demonstrate before a choice of system is made. Careful evaluation of prefabricated systems and laying processes is essential when making comparisons between products.

2.4.5.2 In-situ construction

Shockpads constructed in-situ normally vary in thickness from 15 mm to 30 mm and consist of a polyurethane binder mixed with rubber crumb/shred. Some 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. There are also shockpad/base systems formed using recycled materials which can be considered.

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

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

2.5 Use of MUGAs for non-sporting activities

The use of MUGA as a school playground, overflow car park or for other non-sporting activities may result in damage to the playing surface, will shorten the life of the surface, invalidate the manufacturers' warranty and increase the maintenance demands of the surface. A MUGA designed to satisfy a wide range of sporting demands will not be suitable for other non-sporting activities without compromising its use for sport.

2.6 Use of open access activity areas

In the UK there are MUGAs designed to facilitate non-traditional activity areas where access to the facility is often open, and the surface is not always one considered a sports surface and therefore is NOT dealt with by this document. These areas are often located in urban housing areas and potentially incorporate things like a single basketball net or fixed football goal. Further information on these of facilities can be found in SAPCA's MUGA guidance.

3 Section 2 - General Construction Requirements

3.1 Design Considerations

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

3.1.1 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. The first element to establish is why the facility is needed and how the project will be funded. For projects that require a large amount of grant funding through sports' governing bodies or external funding agencies initial talks should take place to ensure that the proposed location and initial design meets with their strategic plans 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 formation of a project delivery team.

3.1.2 Preliminary Investigations

There are a number of factors that should be considered when developing and designing a MUGA. The cost of a new facility is greatly influenced by site conditions and the proposed size of the facility. Costs will be much higher for engineering a more complex site and it should be recognised at the preliminary stage that some sites are not cost effective to develop as sports facilities. A designer should consider the following factors:

- Topography
- Site geotechnical characteristics
- Access
- Drainage
- Electrical supply
- Water supply
- Trees
- Ground conditions

Before starting a detailed design, the designer will require as much information as possible about the site and its surroundings. Allowing sufficient resources and some pre-project funding for initial information gathering greatly reduces the risk of unforeseen problems, (and increased costs), during the detailed design stage or the construction phase. It is strongly recommended that this information be obtained early in the design stage of the project and be made available to all contractors at the tendering stage.

This information is required confirm the scope of earthworks, sub-base design, and the drainage design:

- Topographic survey
- Ground and site investigation

To establish how the MUGA will fit into the site a topographical survey will be required that will 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

Understanding the ground conditions is vital, as the greatest risk of unforeseen problems and additional cost usually lies in the ground. Gathering information is only the first step and may need to be followed by fieldwork and laboratory testing. The most important element in ground investigation is to confirm the nature and characteristics of the underlying soil or rock. This is completed by either boreholes or trial pits to allow close examination of each layer to provide a detailed engineering description in accordance with BS 5930. The information required from a ground investigation will include the following:

- Ground strength (CBR's)Groundwater level
- The sub-soil hydraulic 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 complex sites such as river flood plains, steeply contoured sites or derelict sites, more extensive site investigation will be required. Professional and site-specific advice is essential. Where a proposed development site is on land that has previously been used for landfill, a full geo-environmental report including contaminant testing will be required to assess the possibility of moving or remove soils from the area.

If floodlighting is to be installed it will be necessary to determine the following information to ensure that the design is suitable for the type of facility and specific sport.

Power required for the number of lighting fittings required.

The details of the LED lighting system.

- Is there a suitable power supply near to the proposed location?
- Lighting design to suit to primary sport with consideration given to other sports.
- Consideration given for the current land classification of the proposed development area.
- Consideration of local planning department and restrictions on the development area.

3.2 Site considerations and location

The location of the MUGA should be sympathetic to its locale and surroundings and any adjacent infrastructure. Early guidance should be sought on local planning policy, land designation, Playing Pitch Strategies, and any other local issues from the Local Planning Authority. Consideration should also be given to the impact on surrounding residential areas, noise, traffic density and flow and the existing network of roads and local amenities. It is likely that a Design and Access statement will be required by the local Planning Authority to highlight these considerations within the design and location of the MUGA.

The design of the MUGA and the access to the facility for users must comply with the requirements of the Equality Act (2010), which is the act that replaced the previous Disability Discrimination Act. Sport England also have a guidance note 'Access for Disabled People' Guidance Note which outlines various considerations that need to be addressed in the design of sports facilities. Depending on the type of project, if it includes buildings or structures then the design will need to comply with Part M of Building Regulations.

3.3 Size, orientation, and gradients

The size of any facility should, where possible, be dictated by the dimensions required by the sports to be played on the facility, however, by the very nature of a MUGA, these requirements maybe compromised. 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 MUGA, especially if funding is being obtained through the governing body. Appendix B shows a series of typical layouts for a variety of MUGAs. Some sports allow compromise in layouts and dimensions but for others the size of the pitch or court is defined.

Table 3 shows recommended the sports' governing bodies recommended dimensions for playing areas and run-offs.

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

It is not uncommon for sports' governing bodies to specify a maximum fall of 1 % (with a recommended 0.5 %) in any direction. The advice to any designer, consultant or installer is to check with the relevant sports' governing body.

Table 3 Typical dimensions for specific sports

Sports	Principal playing area (pitch or court size)		Minimum run-off			
			Run-back or end run-off (per end)		Side-run (per side)	
	Length (direction of play)	Width	Recomm-ended	Minimum	Recomm-ended	Minimum
Tennis	23.77m	10.97m	6.40m	5.49m	3.66m 4.27m (between adjacent courts)	3.05m 3.66m (between adjacent courts)
Netball	30.5m	15.25m	3.05m	2.0m	3.05m 4.0m (between adjacent courts)	1.5m 2.0m (between adjacent courts)
Basketball	**28.0m**	15m	2.0m		3.0m	
Five-a-side football	Ratio of length to width = 2:1		Not applicable - boundary fence of MUGA forms boundary of pitch			
	Typically 37.0m	Typically 18.5m				
Seven-a-side football	Minimum 50.0m Maximum 60.0m	Minimum 30.0m Maximum 40.0m	3.0m	2.0m	3.0m	2.0m
Futsal	Minimum 25.0m Maximum 42.0m	Minimum 15.0m Maximum 25.0m	3.0m	2.0m	3.0m	2.0m
Hockey5s	**32.0m**	18.0m	Optional	2.0m	Optional	2.0m

3.4 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 that will safeguard against surface flooding occurring.
- Not allow excess water to remain present in the construction that 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 client's design criteria.

SAPCA have a *Code of Practice for the Design, Specification and Testing of Bases for Outdoor Synthetic Sports Areas* which includes guidance on drainage systems. The design of the drainage and sub-base layer for a MUGA should apply the principles of this document to ensure that the drainage system is suitable to the location and ground conditions of the MUGA.

Due to the relatively small dimensions of most MUGAs, they do not tend to have any form of sub-base lateral drainage. In most cases a perimeter drain laid around one or more sides of the facility is used. However, larger MUGA's will have lateral drains incorporated beneath the playing area, the centres of which shall be determined by the composition of the subsoil and the designed infiltration and outfall rates. Centres usually range from 5m to 15m. 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 MUGA 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 MUGAs are usually porous, 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 require a planning application for a MUGA to include details of 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.

3.5 Sub-base

SAPCA have a *Code of Practice for the Design, Specification and Testing of Bases for Outdoor Synthetic Sports Areas (2020)*. The design of the sub-base layer for a MUGA should apply the

principles of this document to ensure that the sub-base is suitable for the location and ground condition. The MUGA will be subjected to many different stresses throughout its life due to the varying seasons and climatic conditions that occur. These stresses mainly concern the sub-soil on which the MUGA is built, and can include:

- Frost heave
- Clay shrinkage/swelling
- Settlement
- Ground loading (above the surface)
- Vegetation disturbance (e.g. tree roots/weed growth)
- Flooding
- Faulty or inadequate drainage
- Other types of ground movement

The degree to which the performance and durability of the playing surface will be affected by these forces depends on:

- Site conditions e.g., climatic conditions and the type of sub-soil present.
- Type and depth of construction.

Certain sub-soils are far more prone to the two main causes of serious problems, frost heave and clay shrinkage, and clearly it is important to determine site conditions before designing the sub-base construction. Frost Heave is caused when frost penetrates into susceptible sub-soils that include a lot of fine silty material. The particular pore sizes of these soils draw water by capillary action into the freezing zone, causing ice “lenses” to form which then expand and push up towards the surface. The longer and deeper the period of frost penetration the greater is the effect. After thawing, the surface will eventually settle back but the displacement, and subsequent inconsistent settlement, will leave undulations on the playing surface. Many clay soils are prone to swelling when hydrated and shrinking and cracking when dehydrated. This will often show as cracking in a lawn during a dry summer. Such cracking and settlement or swelling will transmit through to the surface if an insufficient depth of foundation is provided.

The sub-base to any MUGA should therefore 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 construction.
- It 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.

A MUGA's sub-base should be constructed using hard, clean, well-bound, non-frost-susceptible aggregates. These are typically a reduced fines grading (Department of Transport Type 3) aggregate mix or a 28mm to 50mm clean stone capped with a 10mm chipping to act as a blinding layer.

The total construction depth (foundation plus surfacing) is critical for several reasons:

The greater the depth the less chance of frost penetrating into the sub-soil.

The effects of any forces superimposed at the surface are generally spread at an angle through the construction and will be dispersed over a much wider area with a thicker foundation (doubling the thickness will reduce the effect of stresses at formation level by a factor of four).

Thicker foundations provide greater load-bearing capacity and may allow the use of heavier machinery (e.g., laser-controlled pavers), giving more economic and higher quality surfacing with better surface tolerances.

Experience shows the minimum acceptable total construction depth for a MUGA in suitable sites is 215mm, which is significantly below the 450mm that is generally regarded as the potential frost penetration depth for most regions of the UK. Adopting a "belt and braces" approach and using foundations of 450mm would add significantly to the construction costs and many developers would regard this as excessive although it is the only absolute way of guaranteeing no heave at all on frost-susceptible sub-soils. Achieving the right balance between achieving value for money and minimising (if not eliminating) any risk, is not easy - who knows when the next severe winter will happen? Also, to a large extent it depends on the perception and pocket of the client.

Table 4 gives recommendations based on current best practice and the requirements of most clients (i.e., allowing a slight risk of minor displacement). The figures should be used as a guide and may be adjusted to consider specific site information and local knowledge. If in doubt it is recommended that specialist expertise by sought.

Table 4 Guidance on foundation depths for sub-base

Soil Type	Clay or Silt (%)	Potential Frost Action	Potential Shrinkage / Swelling	Foundation depth (mm)	Total Construction Depth (mm
Slightly silty/clayey sand or gravel	0-5	minimal	Minimal	150	215
Silty/clayey gravel	5-15	Slight	Minimal	150	215
Silty/clayey sand	5-15	Medium	Minimal	150 – 200	215 – 265
Very silty/clayey gravel	15-35	slight-medium	Minimal	150 – 200	215 – 265
Very silty/clayey sand	15-35	minimal	minimal-medium	150 – 250	215 – 315
Sandy/gravelly silt or clay	35-65	medium-high	slight-medium	250 - 335	315 – 400
Silt	65-100	medium-very high	slight-medium	300 - 385	365 – 450
Clay	65-100	medium-high	medium-high	300 – 385	365 – 450
Chalk/Soft rocks	65 -100	medium-very high	Minimal	150 - 385	215 – 450
Peat	-	Low	very high	335+	400 +

The figures given in Table 4 show the design depths for any site or soil type. From a construction point of view, however, a tolerance is required on these figures to reflect the practicalities of working on site. It is recommended that at no point on a MUGA should the foundation depth be 25mm below the design depth and that the total area on which the depth is 10% below the design depth should not exceed 10% of the total area.

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 presence of metallic materials in recycled materials can also cause problems to the playing surface if it interacts with acidic rain or an alkaline environment and should therefore not be present.

The foundation material should be laid in layers not exceeding 150 mm, each layer being compacted before the next is laid. Compaction should be undertaken so that when tested with a lightweight deflectometer (Prima or similar) no reading less than 40MPa achieved. 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.

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. Geotextiles are water-permeable fabrics that are laid in sheet form beneath the foundation to provide a number of benefits, including:

- Isolating the foundation and preventing infiltration and contamination by a silt or clay sub-soil.
- Increasing of the load-bearing and structural strength of the foundation.
- The provision of a “slip sheet” to help to prevent cracks from transmitting from the sub-soil to the surface.
- Inhibiting possible weed growth from the sub-soil zone.

Although increasing the cost of construction marginally the benefits of using geotextiles are considered such that they should be included in all new constructions.

3.6 Perimeter edging

To keep the base, sub-base and surfacing from subsiding at the edges a low retaining kerb should be installed at the edges of the MUGA, this kerb will normally be formed of pre-cast concrete and the most common dimension is 150mm x 50mm. Other types of kerbing systems such as in-situ cast concrete or bricks are used in specific circumstances. The level of the top of the kerb should match the type of surfacing being installed, for porous asphalt and polymeric surfaces the top of the kerb should be installed level with playing surface, whereas with synthetic turf the kerb should be installed level with the top of the infill material within the carpet. The kerbs shall be well haunched in suitable concrete, derived from the prevailing soil conditions, the bed and haunching may incorporate movement joints at appropriate spacing’s.

If a 3G synthetic turf surface is to be installed, It is important that the edging design minimises infill dispersion. SAPCA developed a *Code of Practice for the Selection and Use of Sports Performance Infills in 3G Artificial Turf* to ensure that the design and construction of facilities with 3G surfaces are carried out in accordance with this guidance.

3.7 Base construction options

Once a suitable sub-base has been designed for the specific ground conditions there are two alternative constructions which could be used for the base: a bound base (engineered) normally of porous asphalt, 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. 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:

- 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 higher surface level tolerances required for some sports over the life expectancy of the base (around 25-30 years). They are more stable than unbound bases and provide a better guarantee of consistency of playing characteristics over the MUGA playing surface both initially and during its life. In the case of a synthetic turf MUGA, whether a shockpad is required or the carpet is being laid directly onto the base, a bound base is 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 must 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.

For certain types of constructions, surfacing and possibly budget constraints the use of unbound stone bases may be preferable. 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. It may also become necessary to rectify deviations in surface regularity during the life of the synthetic surfacing which can be problematic and costly. The design of these types of bases has not as yet been specified by any standards organisations or sports' governing bodies. Contractors have many differing views on how an unbound stone base should be constructed, generally they are either an extension of the sub-base stone, a layer of clean stone laid and compacted on top of the sub-base, or a blinding layer of stone designed to help consolidate and hold together the sub-base stone. If this type of base is being considered or offered by a contractor a full description of the components and design should be obtained. Site checks should also be carried out at stages during their construction to ensure that the design is being correctly adhered to.

A further advantage of unbound bases is their ability to deform under high impact loads thus improving player 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.

For all MUGA types other than 3G synthetic turf (Type 8) a bound (porous asphalt) base construction is recommended. For third generation synthetic turf MUGAs an unbound base can be used in some situations, although the inherent strength and stability a porous asphalt layer provides is always advantageous.

3.8 Porous asphalt (bases and surfaces)

The base for a MUGA is normally a porous bound construction consisting or either a single layer 40-50mm thick of open-textured porous asphalt or two layers (40mm blinding layer and 25mm surfacing course), either machine or hand laid. These forms of construction have gained acceptance due to their ability to offer the greatest possible level of stability to the final surface, resisting frost heave and spreading surface loading. These factors all mean that it is simpler to replace or upgrade the surface of the MUGA when the need arises.

MUGAs with a porous asphalt surface course as the playing surface a 6mm grade should be used. This would normally be an open textured grade of porous asphalt although medium grades may be used where structural strength is the overriding consideration. Consideration should be given that the ability of a medium grade porous asphalt to allow water to drain through the surface is much less than an open grade. Specifications for coated porous asphalt's include tolerances on the aggregate grading to allow for normal production variations. This will mean that minor variations in texture between different loads of porous asphalt might be apparent in the laid material. However, provided the porous asphalt complies with the required composition specification, its performance should be satisfactory providing it is well laid and compacted. Porous asphalts from different sources may well have different target gradings and to avoid undue texture variations, it is recommended that a single source of supply be used for the surface course on any one MUGA.

The question of what is 'an acceptable texture' can be contentious as many clients fear that an area of porous asphalt with an open texture may have an unacceptable effect on the way a ball rebounds from the surface or the longer-term durability of the surface. When assessing variations in texture the over- riding consideration is 'does the area have a detrimental effect on the way a ball rebounds from the surface'? If it does not it should be considered acceptable.

On MUGAs on which the porous asphalt surface course is not the playing surface an open textured 0/10mm grade is normally used.

Aggregate durability

Geological formations and deposits, which are quarried, are by their very nature variable. However, by initial selection of source and then by the quarrying and processing operations, producers achieve an acceptable and consistent level of aggregate quality and particularly keep the amount of weak or deleterious aggregate to an absolute minimum. It should be recognized, however, that it is not always possible to eliminate weaker aggregate particles. There will, therefore, be the occasional appearance of such weaker aggregate particles in a porous asphalt surface but these do not indicate a significant risk to the performance or durability of the surface. The minimisation of these particles, particularly in respect to their negative effect on the appearance of a painted MUGA surface, is controlled using aggregates that conform to the appropriate categories of Resistance to Fragmentation (BS EN 13043-Clause 4.2.2, PD 6682-2 Clause 3.3.1) and durability (BS EN 13043 Clause 4.2.9, PD 6682-2 Clause 3.3.8).

The ability of the aggregate in a porous asphalt mix to resist weather and wear is important to the durability of the mix. An adequate level of aggregate strength should be provided by a coarse aggregate that conforms to BS EN 3034 Clause 4.2.2 Resistance to Fragmentation, Category LA30 when tested in accordance with the Los Angeles test method given in BS EN 1097-2.

The durability of aggregates and their resistance to weathering effects can be measured by the magnesium sulphate soundness test and it is recommended that the soundness value category of the coarse aggregate should be MS25 when tested by the method given in BS EN 1367-2, if it does not conform to the water absorption category WA242 in accordance with BS EN 13043, Clause 4.2.9.1.

Porosity

For the porous asphalt mix to be porous it needs to contain an adequate proportion of interconnecting voids after compaction. This is ensured by employing an aggregate grading with

a low fine aggregate content when compared to that of the standard BS 4987 medium-graded surface course porous asphalt.

Note: Because of surface tension between fresh bitumen and water, drainage of water through the porous surface can be slow during the very early life of the MUGA. As the initial tension from the bitumen is lost through weathering, then the porosity will improve to ensure that water will have drained away from and through the surface within fifteen minutes of the cessation of rainfall.

Subject to correct aftercare and maintenance, a porous asphalt surface should provide acceptable surface water drainage for several years. This will be dependent on the overall construction being as recommended in this Code of Practice, the type and application rate of any colour coating being suitable, and proper care and maintenance routines being undertaken, particularly for keeping the court free of surface detritus such as mud and leaves.

Mix durability

As long as an adequate binder content is used in the porous asphalt mix and the aggregate is of adequate strength, the mix should be durable and perform to expectations. A minimum binder content of 4.5% is likely to be satisfactory, and the supplier should take account of his production tolerance before setting a target binder content to meet this requirement.

The target binder content selected will also be dependent on the aggregate type and on the target grading employed. Suppliers will consider all these factors to ensure a durable mix.

Resistance to softening

Softening of a porous asphalt playing surface in hot weather is one of the most common sources of customer dissatisfaction. All porous asphalt mixes will, to a certain extent, soften as the temperature rises and harden as it falls, as the bituminous binder that they contain is a thermoplastic material. The degree of softening will depend on the stiffness of the mix, which is principally governed by the stiffness of the binder used in it, and the nature of exposure to direct sun. For example, a porous asphalt laid in a "sun trap" position will be more prone to softening problems than one laid in a shaded area. Also, porous asphalt mixes stiffen-up in service due to bitumen hardening: the older the surfacing, the less likely it is to be affected by softening.

To resist softening, relatively hard bitumen’s need to be used in the porous asphalt mix. It is recommended that a bitumen binder grade no softer than 160/220 penetration is used. To reduce the degree of softening in susceptible areas, a modified binder or additive such as latex or wax may be used. Mixes incorporating latex require higher laying temperatures and laying in cold, wet or windy weather conditions should be avoided and any "double handling" (e.g., wheel barrowing) of the porous asphalt must be kept to a minimum.

Transport and material handling

Coated porous asphalts are transported in insulated lorries which are either double sheeted or utilise the "Easisheet" principle of sheeting to retain the material temperature in transit. Where possible, material should be used direct from the lorry in order to minimise the loss of temperature. When material is tipped on site it should be placed on metal or hard wood sheeting and immediately completely covered with a weatherproof tarpaulin suitably secured to keep it in position. The tarpaulin should be kept in place until all the material has been used, and particularly should be replaced after each batch of material has been removed for laying.

Laying and compaction

For a porous asphalt surface, the porous asphalt binder course and surface course shall be laid at the nominal compacted thicknesses recommended in Table 5. At no point in the construction shall the layer thickness be less than the minimum compacted thickness, which is also stated within Table 5.

Compaction is the most critical operation in the construction of any bituminous surface, especially those incorporating porous asphalts. The compaction effort brings the aggregate constituents into contact with one another providing the mechanism for load bearing, stability, and performance.

Compaction should be commenced as soon as possible without undue displacement of the material under the roller. In all cases compaction should be substantially completed whilst the material is above the minimum specified rolling temperature, which varies according to the grade of binder in the mix (see Table 6). Rolling should continue until all roller marks have been removed, however continued rolling below the minimum temperatures may induce surface cracking and eventual loss of integrity of the material.

Table 6 includes the grades of binder and types of additives commonly used by suppliers. If other grades of binder and/or additives are used, advice on the minimum delivery and rolling temperatures should be sought direct from the supplier. The important factors affecting the final compaction achieved are:

- The temperature at which the material is compacted.
- The mass per roller width.
- The delay between spreading/laying the material and applying compaction.
- The speed and number of roller passes.

The laid thickness of the bituminous material directly affects the rate at which cooling occurs as layers of 30mm and less leave little time for effective compaction. The compaction time is further reduced by low ambient temperatures and even more so by windy conditions. The cooling effect of the wind is greater than that of ambient air temperature. Recommended compacted binder course and surface course thicknesses are given in Table 5.

Table 5 Porous asphalt thicknesses

Materials	Two course (recommended)		One course	
	Nominal compacted thickness	Minimum compacted thickness at any point	Nominal compacted thickness	Minimum compacted thickness at any point
0/6mm surface course (tennis grade)	25 mm	15 mm	40 mm	35 mm
0/10mm surface course	25 mm	15 mm	40 mm	30 mm
0/10 mm binder course	40 mm	30 mm	-	-
0/14 mm binder course	40 mm	30 mm	-	-
0/20 mm Binder course	45 mm	35 mm	-	-

Rollers are categorised according to their dead-weight, mass, and width of roller in contact with the material. Therefore, for a given dead-weight, a roller with a smaller diameter drum exerts greater static linear pressure and thus compacting force.

Table 6 Recommended porous asphalt laying temperatures

Binder grade/ type of additive	Minimum temperature (within 30 minutes of arrival on site)	Minimum temperature (immediately prior to rolling)
250/330 Pen	105°C	75°C
160/220 Pen	115°C	85°C
160/220 Pen + latex	140°C	100°C
160/220 Pen + polymer	140°C	100°C
100/150 Pen	135°C	95°C

It is possible to impose a greater compaction force using a vibratory mechanism. Vibratory rollers are commonly tandem rollers and apply dynamic compaction forces. The frequency and amplitude of the vibration determines the efficiency of compaction and vibratory rollers of a lower mass can achieve a higher compacted density than heavier dead weights. Vibratory rollers should only be employed on bituminous binder courses and not on thin layer surface courses, due to risk of aggregate fracture. The guiding principle for compaction is to use the heaviest roller that can be supported by the construction.

Table 7 gives an indication of the number of compaction passes required by roller type, applying the minimum temperatures immediately prior to rolling, as stated in Table 5, to compact fully a bituminous layer of up to 50mm thickness.

Table 7 Guideline number of compaction passes required by roller type

Roller mass	Type	Minimum number of roller passes
600 - 1,000 Kg/m	Single drum	12
600 - 1,000 Kg/m	Twin drum vibratory	6
1,000 - 2,000 Kg/m	Single drum	8
1,000 - 2,000 Kg/m	Twin drum vibratory	4
Greater than 2,000 Kg/m	Single drum	6

Surface Texture

Porous asphalt surfaces should be laid to an even and consistent texture to ensure an optimum appearance and minimal variation in playing characteristics. Manufacturing and laying operations should be controlled to minimise textural variations. Some degree of textural variation is, however, inherent in certain materials and laying procedures used for tennis court surfacing, such as bitumen porous asphalt. Such variations are acceptable providing that they are not so severe as to significantly affect the playing characteristics, porosity, or strength of the surface, and providing that the appearance of the court is not unreasonably impaired.

Porous asphalt bay joints

Construction joints are inherent in most surfacing systems. They should, however, be neat and even and should not affect the bounce of the ball. Marks left by the roller during the laying of the surface may be visible, particularly in certain light conditions, but they should never be so severe either to deflect a ball in play, or to be detectable underfoot by a player.

Initial settling down period

Porous asphalt surfaces require some degree of extra care when used during the immediate post-construction phase. It is important for purchasers to be fully informed as to when the court may be first used and any precautions that may be necessary until the surface has fully "settled down". This is particularly important in the case of bitumen bound surfaces, which may be subject to some softening during hot weather.

3.9 Paint coatings for porous asphalt MUGAs (types 1 and 2)

Many porous asphalt MUGAs are colour coated to increase their visual appeal. The choice of colour coating is critical to ensure that the MUGA has the level of performance, slip resistance, porosity, and durability that a client may reasonably expect. Factors that need to be considered include:

- The intensity of use – a court subjected to high usage will cause the coating to wear more rapidly than a court used only occasionally.
- The types of footwear that will be worn by players - the use of sports shoes with pronounced tread patterns will cause rapid abrasion of the colour coating.
- The potential for contamination of the surface from debris (leaf litter, foot trafficking dirt etc. and atmospheric pollution) – the movement of grit will abrade the coating.
- The proximity of trees – sap from trees can cause premature failure of the coatings.
- Water-based acrylic paint

The majority of painted porous tennis courts are colour-coated with water-based acrylic paint formulations, which typically contain acrylic resin, water, oxide pigments, mineral fillers and processing aids. The coatings are normally applied using industrial airless spraying equipment.

Solvent-based polyurethane paint and polyurethane / acrylic blends

These paints form a harder wearing and durable coating that are suited to areas of high use such as MUGAs. Due to the higher rigidity of the coating, there is an increased risk of cracking of the porous asphalt surface due to the differential in the thermal expansion rates of porous asphalt and the coating.

Porous asphalt curing

If a MUGA is painted before the bitumen incorporated in the porous asphalt has been allowed to harden adequately, the paint will cure satisfactorily but during periods of hot weather the bitumen below will soften. Foot traffic will break away the hard paint film leaving a black smear, often in the shape of a twisting sole or heel.

Newly laid bitumen has a glossy finish; as it cures, the top layer hardens, and it loses its sheen. It is at this stage that the court is normally considered suitable for spraying. The time it takes for oxidation to occur will vary depending on the nature of the surface and the weather, but it will normally take between two and three weeks in the summer and may take up to three months in the winter.

Preparation prior to painting

The area to be coated with paint or binder should be free of oil and grease and should be swept or blown free of dirt, leaves, grit and debris immediately prior to painting. To minimise the effects of paint-drift the edges of the court and perimeter fencing should be masked with sheeting, boarding or other suitable material for a height of around 1m, dependent on the prevailing wind at the time of spraying. The manufacturers of paints and binders will provide details of the types of protective clothing, facemasks, etc. that are recommended when using their products. If any doubt arises the advice of the manufacturer should be sought.

Weather conditions when painting

Painting should only be undertaken in fine, dry, relatively still weather – this makes programming notoriously difficult for contractors and delays are a common occurrence. After being sprayed onto the porous asphalt surface the paint dries to the stage where it is touch dry, and at this stage it starts its initial curing. This can take between one and twelve hours, depending on temperature, humidity and air movement. Air movement is by far the most important factor in controlling the curing time. Painting should only be undertaken when the temperature of the surface to be coated is above 5°C (40°F) and is likely to remain so for a minimum of six to seven hours. A paint film will cure at temperatures as low as 0°C, though it will take an unacceptably long time to cure at such low temperatures. It is important to remember that the temperature of the ground affects the curing of the paint and that it should be the ground temperature that is measured not the air temperature - many sunny autumn days have an air temperature above 10°C or 15°C whilst the ground temperature (and therefore the film temperature) remains at 2°C or 3°C. As a rule of thumb spraying is normally only undertaken during the period of British Summer Time.

3.10 Polymeric surfaces (Types 3 and 4)

Polymeric surfaces are formed from a complex mix of polyurethane binders and rubber granules with a top coating. The materials are either mixed on site and laid as a wet pour material, normally through a small paving machine (although hand laying is sometimes used) onto an asphalt base, or supplied in factory produced rolls that are bonded to an asphalt base.

When installed as a wet pour system the resulting rubber mat may be colour coated to improve appearance and some surfaces have a clear texture coat spray applied to improve the slip resistance of the surface. Play lines are normally applied using a compatible polyurethane paint.

Polymeric surfaces should meet the relevant requirements of BS EN 14877: Synthetic Surfaces for Outdoor Sports Areas: 2013.

3.11 Synthetic turf surfaces and needle-punch carpets (Types 5 – 10)

The range of artificial grass surfaces is large, and the many different types have a variety of differing playing qualities. As a minimum the surface should meet the requirements of BS EN 15330-1 and/or 2 (2013 edition).

Weather considerations

Artificial grass surfaces can only be laid in certain weather conditions. This is because the types of adhesives used to join the rolls of carpet may not fully bond if laid in very cold or wet conditions and the need for the carpet and sand infill to be dry to allow the sand to flow into the pile of the carpet. Surfaces should only be laid when conditions satisfy those stipulated by the adhesive and

carpet manufacturers. This is very much a case of the experienced contractor knowing best and they should not be pressurised to lay a surface in less-than-ideal conditions just to complete the work on time.

Carpet installation

Prior to laying out the artificial grass carpet the base should be swept to ensure there are no loose stones or other debris lying on it. The artificial grass carpet should then be rolled out in the configuration shown on the seaming plan and the rolls checked for any signs of damage or defects.

Following the checking of the roll, the edges should be overlapped by an amount sufficient to allow trimming and the edges trimmed to produce a good butt joint. After trimming, the gap between the edges should be no more than the distance between each tuft row.

The carpet should then be turned back from the trimmed joint and a carrier tape positioned on the joint line. The tape should be positioned centrally to give a bond width in accordance with the manufacturer's instructions. A water-based "tacky" adhesive may be used under the tape to prevent movement.

Sand application (where applicable)

The surface will not perform correctly, and its durability will be compromised if the carpet is not correctly sanded prior to play. This part of the installation is, therefore, crucial. Before infilling, it is recommended that the entire surface is brushed to aid the turf fibre to stand upright.

The sand should be applied evenly in stages ensuring that the sand is brushed into the pile in such a way that the pile remains upright. Extreme care and attention should be taken when applying the sand. The dressing must be finished to a constant depth within the base of the pile.

If using a wheeled vehicle to transport sand across the surface, make sure that the tyres are smooth – tyres with treads such as herring bone tyres will permanently mark the playing surface. The recommended ground pressure of tyre to turf surface is between 8 and 11 pounds per square inch. Drive with care over previously sanded areas and do not make sharp turns or stop suddenly.

It may be necessary to return to site to top up sand levels after installation. The amount needed for top dressing can only be determined on an individual basis.

Sports Performance Infill application (where applicable)

The surface will not perform correctly, and its durability will be compromised if the installation of the sports performance infill is not brushed into the carpet to the required levels prior to play. This part of the installation is, therefore, crucial.

If using a wheeled vehicle to transport sand across the surface, make sure that the tyres are smooth – tyres with treads such as herring bone tyres will permanently mark the playing surface. The recommended ground pressure of tyre to turf surface is between 8 and 11 pounds per square inch. Drive with care over previously sanded areas and do not make sharp turns or stop suddenly.

It may be necessary to return to site to top up infill levels after installation. The amount needed for top dressing can only be determined on an individual basis.

The sports performance infill used within the pitch surface system should be formally registered on SAPCA's Quality Control Protocol for Sports Performance Infills. Click here

Infill retention

Most 3G synthetic surfaces contain a combination of stabilising infill (sand) and sports performance infill comprising polymeric (rubber and plastic) materials to achieve the required sports performance and therefore provide a suitable playing surface.

If a 3G synthetic turf surface is to be installed, it is important that the perimeter design minimises the potential for infill dispersion. SAPCA developed a *Code of Practice for the Selection and Use of Sports Performance Infills in 3G Artificial Turf* to ensure that the design and construction of facilities with 3G surfaces are carried out in accordance with this guidance.

At the time of publication this is guidance to include designs to minimise infill dispersion, however, legislation may make these designs mandatory in the future. This would mean that by not designing the MUGA with infill retention methods during construction, potentially more expensive retrofitting maybe required in the future.

3.12 Corrective/Remedial Action

Some surfaces, most notably porous asphalt, are extremely difficult to repair imperceptibly. A degree of reasonableness should therefore be applied when assessing minor areas of non-compliance for their effect on performance and suitability for purpose, and the appropriate extent of any remedial action.

Where remedial works are required, the repaired surface should match adjoining areas in colour, texture and levels and, except where invisible mending can be achieved, (e.g., some synthetic grass surfaces), should be replaced to the nearest play lines or construction joints. Joints should be neat, straight and unobtrusive.

3.13 Fittings and Equipment

The sports equipment chosen needs to reflect the multi-use nature of the facility. Generally, all equipment should be able to be removed to enable the range of sports to be played, although some fixed equipment may be possible if its location does not affect the use of the area for the other sports for which it was designed.

There is a wide range of nets, posts, goals, division netting and rebound boards to choose from. Consideration should be given to the precise use of each facility, so that the change of usage from one sport to another can take place with the minimum of effort and inconvenience.

Nets, posts and goals can be free-standing, and therefore easily moved, though it is important to make proper provision for their storage when not required, from the point of view of both safety and security. **It is vital that great care should be taken to ensure the safe anchorage of all free-standing and folder away equipment. It is also imperative that the equipment being installed and used complies with the relevant EN standard**.

- Football goals (full size) should comply with BS EN 748 or preferably FIFA approved.
- Five-a-side or small-sided football metal goals should comply with BS EN 16579.

- Handball goals should comply with BS EN 749.
- Hockey goals should comply with BS EN 750 or preferably FIH approved.
- Netball goal posts should be supplied with protective post pads in accordance with England Netball requirements.
- Tennis posts and nets should comply with BS EN 1510.

Recessed sockets in the playing surface are practical and usual for surfaces such as porous asphalt and polymeric, though less practical for sand-filled synthetic grass surfaces. Whilst providing a convenient solution to fixing equipment, the socket covers can be slippery and considered undesirable by sports such as netball. Also available are proprietary sports equipment systems, which offer high quality bespoke solutions, such as integrated surround fencing and a variety of goal units.

Equipment storage

Portable sports equipment can be stored outdoors – it is designed to be exposed to the elements, however, specialist non-personal equipment e.g., training cones, goals netting etc are best kept in a secure facility or vandal resistant storage container close to the MUGA.

Where football in its various forms is likely to be played, it is sensible to build into the perimeter fence suitably sized recesses to accommodate and anchor portable soccer goals. The design should ensure there is sufficient height clearance in the fence goal recess to prevent cranial and thoracic injury - largely caused by someone running towards the goals or keeping goal. The design should ensure it is easy to retrieve balls from the fence recesses and goal itself (goals may not even require netting for certain standards of play). Above all the ability to securely anchor the frame of the goals to prevent them toppling over is paramount.

If goals are required to stand inside the perimeter fence line during play it is essential, they are returned to storage recesses when the full pitch (or portions), are to be used. Beyond the play lines, run-offs are provided to ensure users can stop safely, so it is important to ensure that equipment is not stored in them.

Where possible the design of the MUGA should allow for portable football and hockey goals to be relocated into fence design recesses, conveniently located behind the goal locations at each end of the facility. Such recesses should have secured posts of sufficient height (equivalent to the main perimeter fence height) with a high level permanent tensioned wire - to allow a netting to be pulled across to containment for seven-a-side football end zone utilisation of the main pitch, when the main pitch goals are retracted into their equipment recesses.

To prevent the migration of infill from the playing surface of the MUGA to the external environs of the pitch, all portable equipment should be stored within the perimeter of the MUGA. Evidence shows that infill can be moved from the pitch to the outside environment if portable equipment is moved and stored externally to the perimeter of the MUGA.

3.14 Perimeter Fencing

SAPCA has produced a *Code of Practice for the Construction and Maintenance of Fencing Systems for Sports Facilities*. This document details the choice of a fencing system within the

marketplace and also highlights requirements for construction and maintenance. It also highlights the most appropriate fencing type for the sport being played.

If a 3G synthetic turf surface is to be installed, it is important that the edging design minimises infill dispersion. SAPCA developed a *Code of Practice for the Selection and Use of Sports Performance Infills in 3G Artificial Turf* to ensure that the design and construction of facilities with 3G surfaces are carried out in accordance with this guidance.

On all types of MUGA, rigid twin bar mesh fencing is considered more appropriate due to the ability to withstand the repeat impacts from balls. Where tennis and netball are the primary usage, rolled weldmesh could be considered. A fencing contractor should be able to demonstrate a variety of options and advise on the advantages and disadvantages of each fencing system.

All gate thresholds should be level or slightly ramped (i.e., not stepped) to avoid trip points and to allow disabled persons access. Gates should also be positioned so as not to create “tight” gathering or milling points, especially where pitch/games area team changeovers are scheduled.

Divider netting and screening

To maximise the use of larger MUGAs, good quality division netting can be installed to split the playing area into separate, smaller areas of activity, as required. Care should be taken in the selection of the netting to always ensure the safety of players, avoiding, as far as possible, potential trip hazards. The greatest care should be taken if site screening or windbreak materials are to be hung on the surround fencing, to ensure that the design of the fencing is sufficiently robust. A heavy-duty surround system will normally be required for this purpose and provision (recesses) should be made to store the netting off the playing are when not in use.

Ball rebound systems

Where appropriate, particularly on MUGAs where five-a-side football is to be played, a rebound fencing system should be incorporated. This would normally be done using twin bar rebound panels, however, rebound walls or board system can also be installed. Rebound fencing, walls or boards can be constructed from a variety of materials and may be stained or painted in order to improve their aesthetic appearance. There is a preference for rebound fencing as this allows direct viewing to the MUGA benefitting both spectator viewing and security and also allows air flow and light onto the MUGA. Consideration should be given to the design details within SAPCA’s *Code of Practice for the Selection and Use of Sports Performance Infills in 3G Artificial Turf*.

3.15 Sports Lighting

The inclusion of a sports lighting system in the construction of a MUGA is often essential to ensure that the area is commercially viable and offering year-round provision of sport. Due to the sensitive nature of sports lighting, consideration needs to be given to the location of the facility during the design and planning phase to ensure that the use of lighting will be permitted. Specialist advice will often 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

Typical lighting performance levels for MUGAs are detailed in Table 8.

Table 8 Typical MUGA lighting levels based on principal sports use

Sport	Illumination standards based on measurements taken after dark at ground level	
	Maintained average luminance	Uniformity (Min/Ave)
Tennis, competitive Netball, Basketball	400 lux	≥ 0.7
Football, general sports training, causal play (all sports)	200 lux	≥ 0.7
Hockey	350 lux	≥ 0.7

3.16 Pitch usage monitoring systems

The inclusion of pitch usage monitoring systems has become more frequently used, especially on full size football and rugby pitches. The systems which are located on floodlighting columns operate through 'cloud' technology and require either WIFI or mobile phone sim card technology for operation.

3.17 Remote access facility management

To control access through an online booking system it is possible to control the access to MUGAs using an access system where the gate is controlled by a 'cloud' based operating system. The electro-magnet gate can be opened using pin activation or card reader device and requires either WIFI or mobile phone sim card technology for operation.

3.18 Quality Control and Key Stage Inspections

To ensure that all components used during the construction of a MUGA meets the specified requirements a system of quality control should be established with the contractor. Furthermore, the use of 'Key Stage Inspections' mean that checks on both materials and workmanship are being carried out throughout the construction period.

3.18.1 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:

- On completion of the formation, to check position, size, levels and gradients.

- On 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.
- On completion of the installation of the sub-base, to check that the correct depth has been installed and that level tolerances have been met and the setting of the edgings is correct.
- On completion of the base again to check that level and thickness requirements have been met.
- On completion of the shockpad to check thickness (if required).
- On completion of the surface to ensure consistency (and if required infill depth across the surface).
- On completion of the line markings to check the evenness and quality.

3.18.2 Performance testing on completion (if required)

The specification for any MUGA 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 Standards. Appendix A details the applicable performance and construction characteristics schedules for the various surfacing and construction types.

Where performance testing is required, the tests should be carried out by independent accredited laboratories. Details of suitable test laboratories can be obtained from SAPCA.

If performance testing is to be carried out on the completed facility, it is recognised that some types of MUGA surfacing do not reach their normal playing performance until the surface has settled down requiring testing to be undertaken after a couple of month's use of the MUGA. The purpose of these tests is to ensure that the completed facility meets the performance and construction requirements laid out in the specification for the project.

4 Section 3 – Maintenance and Management of the MUGA

The maintenance of all types of sports surfacing 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 general housekeeping carried out by the owner/operator to more specialist 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 / or manufacturer of the surface.

As part of their contractual obligations under the Construction Design and Management Regulations, 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 Operations and Maintenance manual which should be provided to the client at completion of the works

SAPCA has produced a *Code of Practice for the Maintenance of all Synthetic Sports Surfaces* and a *Code of Practice for the Maintenance of all Tennis Courts*, which describe in detail the maintenance requirements of the various surfaces used on MUGAs.

Most surfaces installed on MUGA's are fully permeable, and hard-wearing, however, to ensure that the surface continues to meet the specific performance requirements throughout its 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.

Maintenance procedures should be 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 MUGA.
- The facility looks well-kept at all times.
- Ensure that the specific performance requirements are met.

4 Section 4 – Considerations for developing a project

4.1 Project checklist

1. Key points to consider when developing a MUGA:
2. Location for proposed MUGA should be considered in relation to noise and light disturbance to the surrounding environment and neighbourhood.
3. Position of the MUGA and its surrounds suitable for player access (including wheelchair users) and ongoing maintenance.
4. Planning consent for the proposed scheme will be required.
5. Tree, acoustic, ecological, or environmental assessment reports may be required to support the planning application.
6. Playing surface should be suitable for the intended sporting usage.
7. Sports lighting design to achieve minimum performance criteria for the level of usage, with details also given for luminaire mounting and height.
8. Surround fencing should be suitable for the intended sporting usage.
9. If a 3G playing surface is being installed the requirements for infill migration prevention should be adhered to.
10. Non-sporting use on community sites should be considered when selecting the playing surface.

When considering funding options, contact SAPCA or the relevant sports' governing body to assess whether funding would be available.

Appendix A - Performance and construction requirements for MUGAs

Type 1 MUGA		Porous asphalt playing surface designed for tennis, basketball, etc		
Property	Test method	Number of test positions	Test conditions	Acceptable range
Slip resistance	BS EN 16837	Minimum 5 per 600m^2 + two examples of each line marking	Dry and Wet	≥ 60
Water permeability	BS EN 12616	Minimum 3 tests per MUGA block	Wet	≥150mm/h
Surface regularity	BS EN 13036-7	Total playing area	N/A	No undulations greater than 6mm (1)
Slope	Surveyor's level	Principal gradients	N/A	Single plane ≤ 1%
Deviation from design level	Surveyor's level	10 m grid	N/A	± 25 mm
Note 1	A certain number of deviations (of up to 4mm above) are permitted from the tolerances providing when measured under a 1m straightedge, the deviation does not exceed the tolerances stated above for the maximum gap beneath a 3m straightedge. Deviations over 1000mm in length are considered to be multiple deviations (e.g. a 1.8m long ridge is considered to be two deviations).			

Type 2 MUGA		Porous asphalt playing surface designed for Netball		
Property	Test method	Number of test positions	Test conditions	Acceptable range
Slip resistance	BS EN 16837	Minimum 5 per 600m^2 + two examples of each line marking	Dry and Wet	≥ 75
Water permeability	BS EN 12616	Minimum 3 tests per MUGA block	Wet	≥150mm/h
Surface regularity	BS EN 13036-7	Total playing area	N/A	No undulations greater than 6mm (1)
Slope	Surveyor's level	Principal gradients	N/A	Single plane ≤ 1%
Deviation from design level	Surveyor's level	10 m grid	N/A	± 25 mm
Note 1	A certain number of deviations (of up to 4mm) are permitted from the tolerances providing when measured under a 1m straightedge, the deviation does not exceed the tolerances stated above for the maximum gap beneath a 3m straightedge. Deviations over 1000mm in length are considered to be multiple deviations (e.g., a 1.8m long ridge is considered to be two deviations).			

Type 3 MUGA		Polymeric playing surface designed for netball, tennis, basketball, etc		
Principle materials standard		BS EN 14877		
Property	Test method	Number of test positions	Test conditions	Acceptable range
Slip resistance	BS EN 16837	Minimum 5 per 600m^2 + two examples of each line marking	Dry and Wet	≥ 75
Basketball rebound	BS EN 12235	5	Prevailing site conditions	≥ 80%
Tennis ball rebound	BS EN 12235	5	Prevailing site conditions	≥ 80%
Shock absorption	BS EN 14808	5	Prevailing site conditions in range 5°C - 30°C	25% - 44%
Vertical deformation	BS EN 14809	5	Prevailing site conditions in range 5°C - 30°C	≤ 6.0 mm
Water permeability	BS EN 12616	Minimum 3 tests per MUGA block	Wet	≥150 mm/h
Thickness	BS EN 1569	5	N/A	≥ 90% of manufacturer's declaration
Tensile strength	BS EN 12330	See note 1	-	≥ 0.4 MPa
Surface regularity	BS EN 13036-7	Total playing area	N/A	No undulations greater than 6mm (2)
Slope	Surveyor's level	Principal gradients	N/A	Single plane ≤ 1%
Deviation from design level	Surveyor's level	10 m grid	N/A	± 25 mm
Note 1	During each day of installation, a 300 mm x 300 mm sample tray representing the installed surface shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 2	A certain number of deviations (of up to 4mm) are permitted from the tolerances providing when measured under a 1m straightedge, the deviation does not exceed the tolerances stated above for the maximum gap beneath a 3m straightedge. Deviations over 1000mm in length are considered to be multiple deviations (e.g., a 1.8m long ridge is considered to be two deviations).			

Type 4 MUGA		Polymeric playing surface – no netball or tennis use		
Principle materials standard		**BS EN 14877 (multi-sport)**		
Property	Test method	Number of test positions	Test conditions	Acceptable range
Product identification	As detailed in BS EN 14877-1 (2013 edition)			
Slip resistance	BS EN 16837	Minimum 5 per 600m^2 + two examples of each line marking	Prevailing site conditions in range 5°C - 30°C	≥ 55
Basketball rebound	BS EN 12235	5	Prevailing site conditions in range 5°C - 30°C	≥ 80%
Shock absorption	BS EN 14808	5	Prevailing site conditions in range 5°C - 30°C	25% - 44%
Vertical deformation	BS EN 14809	5		≤ 6.0 mm
Water permeability	BS EN 12616	Minimum 3 tests per MUGA block	Wet	≥150 mm/h
Thickness	BS EN 1569	5	N/A	≥ 90% of manufacturer's declaration
Tensile strength	BS EN 12330	See note 1	-	≥ 0.4 MPa
Surface regularity	BS EN 13036-7	Total playing area	N/A	No undulations greater than 6mm (2)
Slope	Surveyor's level	Principal gradients	N/A	Single plane ≤ 1%
Deviation from design level	Surveyor's level	10 m grid	N/A	± 25 mm
Note 1	During each day of installation, a 300 mm x 300 mm sample tray representing the installed surface shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 2	A certain number of deviations (of up to 4mm) are permitted from the tolerances providing when measured under a 1m straightedge, the deviation does not exceed the tolerances stated above for the maximum gap beneath a 3m straightedge. Deviations over 1000mm in length are considered to be multiple deviations (e.g., a 1.8m long ridge is considered to be two deviations).			

Type 5 MUGA		Sand filled synthetic turf with shockpad		
Principle materials standard		BS EN 15330-1		
Property	Test method	Number of test positions	Test conditions	Acceptable range
Product identification	As detailed in BS EN 15330-1 (2013 edition)			
Hockey ball rebound	BS EN 12235	5	Prevailing site conditions in range 5°C - 30°C	≤ 70%
Football rebound	BS EN 12335	5	Prevailing site conditions in range 5°C - 30°C	45% - 90%
Hockey ball roll	BS EN 12234	5	Prevailing site conditions in range 5°C - 30°C	≥ 8.0m
Football ball roll	BS EN 12234	5	Prevailing site conditions in range 5°C - 30°C	4.0m – 18.0m
Shock absorption	BS EN 14808	5	Prevailing site conditions in range 5ºC - 30ºC	35% - 55%
Water permeability	BS EN 12616	Minimum 3 tests per MUGA block	Wet	≥150 mm/h
Carpet joint strength	BS EN 12228	See Note 1	-	As detailed in BS EN 15330
Tensile strength of shockpad	BS EN 12330	Insitu shockpads See note 2	-	≥ 0.15 MPa
Surface regularity	BS EN 13036-7	Total playing area	N/A	No undulations greater than 6mm (3)
Slope	Surveyor's level	Principal gradients	N/A	≤ 1%
Deviation from design level	Surveyor's level	10 m grid	N/A	± 25 mm
Note 1	During each day of carpet jointing a 500 mm x 500 mm samples representing the method of carpet seaming shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 2	During each day of shockpad installation a 300 mm x 300 mm sample tray representing the installed surface shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 3	A certain number of deviations (of up to 4mm) are permitted from the tolerances providing when measured under a 1m straightedge, the deviation does not exceed the tolerances stated above for the maximum gap beneath a 3m straightedge. Deviations over 1000mm in length are considered to be multiple deviations (e.g., a 1.8m long ridge is considered to be two deviations).			

Type 6 MUGA		Sand filled synthetic turf without shockpad – principle use tennis		
Principle materials standard		BS EN 15330-1		
Property	Test method	Number of test positions	Test conditions	Acceptable range
Product identification	As detailed in BS EN 15330-1 (2013 edition)			
Tennis ball rebound	BS EN 12235	3 per tennis court	Prevailing site conditions in range 5°C - 30°C	≥ 80%
Tennis Surface Pace	BS EN 13865	3 per tennis court	Prevailing site conditions in range 5°C - 30°C	Same classification as manufacturer's declaration
Shock absorption	BS EN 14808	2 per tennis court	Prevailing site conditions in range 5ºC - 30ºC	≥ 90% of manufacturer's declaration
Water permeability	BS EN 12616	Minimum 3 tests per court block	Wet	≥150 mm/h
Carpet joint strength	BS EN 12228	See Note 1	-	As detailed in BS EN 15330
Surface regularity	BS EN 13036-7	Total playing area	N/A	No undulations greater than 6mm (2)
Slope	Surveyor's level	Principal gradients	N/A	Single plane ≤ 1%
Deviation from design level	Surveyor's level	10 m grid	N/A	± 25 mm
Note 1	During each day of carpet jointing a 500 mm x 500 mm samples representing the method of carpet seaming shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 2	A certain number of deviations (of up to 4mm) are permitted from the tolerances providing when measured under a 1m straightedge, the deviation does not exceed the tolerances stated above for the maximum gap beneath a 3m straightedge. Deviations over 1000mm in length are considered to be multiple deviations (e.g., a 1.8m long ridge is considered to be two deviations).			

Type 7 MUGA		Sand dressed synthetic turf with shockpad		
Principle surfacing standard		BS EN 15330-1		
Property	Test method	Number of test positions	Test conditions	Acceptable range
Product identification	As detailed in BS EN 15330-1 (2013 edition)			
Hockey ball rebound	BS EN 12235	5	Prevailing site conditions in range 5°C - 30°C	≤ 70%
Hockey ball roll	BS EN 12234	5	Prevailing site conditions in range 5°C - 30°C	≥ 8.0 m
Shock absorption	BS EN 14808	5	Prevailing site conditions in range 5ºC - 30ºC	≥ 40%
Water permeability	BS EN 12616	Minimum 3 tests per MUGA block	Wet	≥150 mm/h
Carpet joint strength	BS EN 12228	See Note 1	-	As detailed in BS EN 15330
Tensile strength of shockpad	BS EN 12330	Insitu shockpads See note 2	-	≥ 0.15 MPa
Surface regularity	BS EN 13036-7	Total playing area	N/A	No undulations greater than 6mm (3)
Slope	Surveyor's level	Principal gradients	N/A	≤ 1%
Deviation from design level	Surveyor's level	10 m grid	N/A	± 25 mm
Note 1	During each day of carpet jointing a 500 mm x 500 mm samples representing the method of carpet seaming shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 2	During each day of shockpad installation a 300 mm x 300 mm sample tray representing the installed surface shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 3	A certain number of deviations (of up to 4mm) are permitted from the tolerances providing when measured under a 1m straightedge, the deviation does not exceed the tolerances stated above for the maximum gap beneath a 3m straightedge. Deviations over 1000mm in length are considered to be multiple deviations (e.g., a 1.8m long ridge is considered to be two deviations).			

Type 8 MUGA		Long pile synthetic turf		
Principle materials standard		BS EN 15330-1		
Property	Test method	Number of test positions	Test conditions	Acceptable range
Football rebound	BS EN 12335	5	Prevailing site conditions in range 5°C - 30°C	45% - 75%
Football ball roll	BS EN 12234	5	Prevailing site conditions in range 5°C - 30°C	≤ 10.0m
Shock absorption	BS EN 14808	5	Prevailing site conditions in range 5ºC - 30ºC	55% - 70%
Vertical deformation	BS EN 14809	5	Prevailing site conditions in range 5ºC - 30ºC	4mm – 9mm
Head Injury Criteria (2)	BS EN 1177 / IRB Reg. 22	5	Prevailing site conditions in range 5ºC - 30ºC	≥ 1.0m (3)
Water permeability	BS EN 12616	Minimum 3 tests per MUGA block	Wet	≥150 mm/h
Carpet joint strength	BS EN 12228	See Note 4	-	As detailed in BS EN 15330-1
Tensile strength of shockpad	BS EN 12330	Insitu shockpads See note 5	-	≥ 0.15 MPa
Surface regularity	BS EN 13036-7	Total playing area	N/A	No undulations greater than 10 mm (6)
Slope	Surveyor's level	Principal gradients	N/A	≤ 1%
Deviation from design level	Surveyor's level	10 m grid	N/A	± 25 mm
Note 1	When site conditions permit			
Note 2	Only necessary when contact rugby training is to take place on the MUGA			
Note 3	Facilities used for any form of training / competitive rugby played on synthetic turf should comply to the requirements of World Rugby.			
Note 4	During each day of carpet jointing a 500 mm x 500 mm samples representing the method of carpet seaming shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 5	During each day of shockpad installation a 300 mm x 300 mm sample tray representing the installed surface shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 6	A certain number of deviations (of up to 4mm) are permitted from the tolerances providing when measured under a 1m straightedge, the deviation does not exceed the tolerances stated above for the maximum gap beneath a 3m straightedge. Deviations over 1000mm in length are considered to be multiple deviations (e.g., a 1.8m long ridge is considered to be two deviations).			

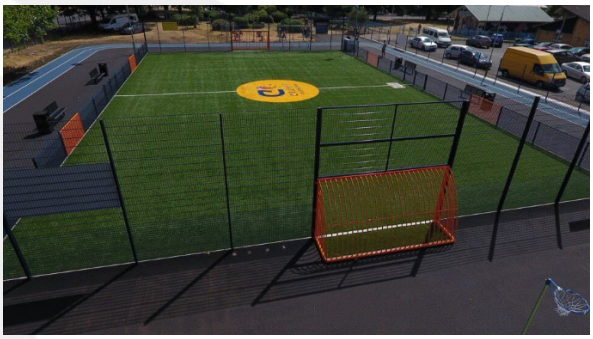
Type 9 MUGA		Needle punch surface with shockpad		
Principle surfacing standard		BS EN 15330-2		
Property	Test method	Number of test positions	Test conditions	Acceptable range
Product identification	As detailed in BS EN 15330-2			
Hockey ball rebound	BS EN 12235	5	Prevailing site conditions in range 5°C - 30°C	≤ 70%
Football rebound	BS EN 12335	5	Prevailing site conditions in range 5°C - 30°C	45% - 90%
Hockey ball roll	BS EN 12234	5	Prevailing site conditions in range 5°C - 30°C	5.0m – 18.0m
Football ball roll	BS EN 12234	5	Prevailing site conditions in range 5°C - 30°C	4m – 18.0m
Shock absorption	BS EN 14808	5	Prevailing site conditions in range 5ºC - 30ºC	35% - 55%
Water permeability	BS EN 12616	Minimum 3 tests per MUGA block	Wet	≥150 mm/h
Carpet joint strength	BS EN 12228	See Note 1	-	≥ 25N/100mm
Tensile strength of shockpad	BS EN 12330	See note 2	-	≥ 0.15 MPa
Surface regularity	BS EN 13036-7	Total playing area	N/A	No undulations greater than 6mm (3)
Slope	Surveyor's level	Principal gradients	N/A	≤ 1%
Deviation from design level	Surveyor's level	10 m grid	N/A	± 25 mm
Note 1	During each day of carpet jointing a 500 mm x 500 mm samples representing the method of carpet seaming shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 2	During each day of shockpad installation a 300 mm x 300 mm sample tray representing the installed surface shall be prepared and left on site for at least 48 hours to cure before being sent to the test laboratory for testing.			
Note 3	A certain number of deviations (of up to 4mm) are permitted from the tolerances providing when measured under a 1m straightedge, the deviation does not exceed the tolerances stated above for the maximum gap beneath a 3m straightedge. Deviations over 1000mm in length are considered to be multiple deviations (e.g., a 1.8m long ridge is considered to be two deviations).			

Appendix B – MUGA layouts

Porous asphalt MUGA comprising 2 x tennis courts, 2 x netball courts and 2 x 5-a-side football pitches with 4m high twin bar fencing including 1.2m high rebound panels and a dividing net between courts.

Fixed and folding football goal housed within a recess.

Porous asphalt MUGA comprising 1 x basketball court, 1 x netball court, 1 x tennis courts and jogging circuit.



3G synthetic turf MUGA with football as primary use comprising twin bar perimeter fencing. External to the football are netball posts and an additional jogging track.