

**The SAPCA Code of Practice
for the Construction and Maintenance
of Tennis Courts**



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The Lawn Tennis Association

The Code of Practice for the Construction and Maintenance of Tennis Courts has been produced in consultation with The Lawn Tennis Association, and is recognised and supported by the LTA for the construction of tennis courts in the UK.

The LTA provides free advice and guidance on tennis facility development. For further information please contact the LTA on 020 8487 7000.

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Figure 1 Typical cross-section of court construction



Glossary of Terms

The court	The entire facility from external boundary to external boundary. Where courts are laid side by side with a common side-run half of the common side-run is included.
Total Playing Area (TPA)	Normally considered as the court as described above. For certain parameters (e.g. floodlighting) the TPA may be reduced in size from the total area to specified dimensions beyond the court markings.
Principal Playing Area (PPA)	The area of the court located within the outer play lines of the court.
Run-back	The areas beyond the base lines at either end of the court.
Side-run	The areas beyond the outer lines at either side of the court.
Common side-run	A shared side run between two courts are laid side by side.
Formation	The prepared natural ground on which the court is built.
Base	The foundation of the court normally formed from graded aggregates.
Macadam binder course	A layer of coarse macadam that is laid on the base to provide stability and strength to the finer grade macadam laid on top of it; used to be known as the base course.
Macadam surface course	A layer of 6mm or 10mm macadam laid either as the playing surface or as the receiving layer for a synthetic surface; used to be known as the wearing course.
Artificial grass/synthetic turf	A piled carpet, normally of tufted or needle punch construction, that is designed to replicate the appearance (not necessarily the playing characteristics) of natural grass.
Impervious acrylic courts	Surfaces formed from layers of acrylic resin laid on an impervious base to provide a true and consistent playing surface.
Porous acrylic	Porous surfaces designed to replicate the playing characteristics of impervious acrylic surfaces.
Clay	A range of unbound mineral surfaces that traditionally have a slow surface pace and allow players to slide. Within this general group is French Clay (as used at the French Open), European Clay, American Fast-dry, shale and blaes.
Synthetic clay	Surfaces designed to replicate the playing qualities of clay surfaces, but not suffer from the climatic limitations often associated with clay surfaces.
Polymeric	Sheet or in situ laid surfaces formed from rubber bound together with a binder (normally polyurethane).

Introduction

The Sports and Play Construction Association (SAPCA) has produced this document to provide prospective clients and specifiers with guidance on the basic construction requirements and specifications currently employed in building tennis courts. The standards outlined throughout the document have been recognised and supported as the minimum standard level for the construction of tennis courts in the UK.

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 surface and form a useful reference in the design and construction process.

SAPCA highly recommend that experienced, professional consultants be appointed to provide the necessary level of expertise in designing and detailing sports facilities and ensuring compliance with all of the current legislation.

Notes To Be Read In Conjunction with the Code of Practice

- This Code of Practice is intended for use by tennis court contractors, sports facility design professionals and tennis court purchasers and owners. The Code of Practice should not be used as a substitute for carrying out appropriate surveys and obtaining professional advice in individual circumstances. Although the Code of Practice has been produced by reference to tennis courts constructed under normal climatic conditions in the United Kingdom, the Sports and Play Construction Association cannot accept any responsibility whatsoever for any loss, damage or injury whatsoever 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 meet. As guideline specifications, however, they do not supersede a reasonable interpretation of the specification and terms of contract applying in each contract. For individual projects, variations in climate, soil conditions, topography and other site specific conditions may necessitate standards of specification greater than those recommended within the Code of Practice.
- Parties not experienced in tennis court construction are strongly advised to consult qualified contractors and court construction consultants. Details of experienced tennis court contractors and consultants can be provided by the Sports and Play Construction Association.
- Whilst the term “asphalt” is the internationally accepted technical name for all surfaces which are composed of a mixture of bitumen and stone, this Code of Practice uses the generic term “macadam”, as this is still the commonly used name for tennis court asphalts within the UK.
- 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 tennis court.
- In the interests of clarity and consistency the minimum compacted depth is also specified, in order 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, whilst accurate at the time of publication, may be subject to change at a future date. Due to changing technology and new developments in construction methods, revisions to the recommendations are likely, and only the most recent edition of the Code of Practice should therefore be used.
- A permanent joint committee will keep under review the use of the Code of Practice and will consider any suggestions for amendment, which should be addressed to the Chief Executive, The Sports and Play Construction Association, Federation House, Stoneleigh House, Warwickshire, CV8 2RF. Revision to the Code of Practice will be made when such action is considered appropriate.

The Sports and Play Construction Association (SAPCA)

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

SAPCA's Aims and Objectives

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

www.sapca.org.uk

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

Further information

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

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Prologue

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

- The first section covers performance testing of tennis surfaces and the types of testing: surface pace, slip resistance, shock absorption and water permeability. It also highlights the variations in the surfaces that are available and how each one can be suited to specific needs
- The second section guides the reader through a detailed account of the construction guidelines for each surface. It covers such detail as the weather considerations when constructing the courts, drainage issues, dimensions and orientation. The general requirements of the playing surfaces are also included detailing; evenness, porosity, surface texture, joints, initial settling down period and finally corrective action, if needed. The diagram on the following page is designed to help potential clients make the correct decisions at the right times by looking at the ideal routes a project may take from proposal to completion and the information required at each stage
- Section three is a maintenance guide for each of the five different court surfaces. It details the main maintenance procedures and why each one is important and includes method variations that need to be made for the differing infill types that may be used.
- Section four, resurfacing and reconstruction, details the procedure that is undertaken when any court type needs replacing or reconstructing. It provides advice on what to do with edgings, roots, drainage systems, dimensions and gradient issues.

Construction of a Tennis Court

This phase reviews the project brief and considers factors such as; location, usage, funding, procurement and project management.

1. Project Brief

This phase can include the development of a business plan, planning application and funding application. A consultant can be appointed during this phase if required, this will normally be for a large project.

2. Project Feasibility

Prior to the design phase a detailed site investigation is required. This includes topographical, geotechnical, electrical and drainage surveys. This may not be necessary on a small project.

3. Site Investigation

This phase includes the production of full design specifications and technical drawings.

4. Design Specification

In this section a review of the tender submissions is undertaken. This includes tender evaluation, short-listing and eventual contractor selection.

5. Tender Process

This phase includes the construction of the facility. If required independent quality control is undertaken to assess build quality and design specification conformity.

6. Construction Period

This section includes the hand-over of the completed project. If required performance testing should be undertaken to ensure compliance. Additionally, a maintenance regime should be provided by the installer.

7. Project Completion

This phase includes the ongoing maintenance programme and warranty period of the installation. As required performance tests are undertaken to monitor surface behaviour.

8. Aftercare

1 Section One: General Information and Surface Selection

1.1 Types of playing surface

1.1.1 Macadam Surfaces

1.1.1.1 British Standard Coated Macadam (BS 4987)

Countless thousands of courts have been built, especially in public parks and schools, employing a bitumen macadam surfacing manufactured to the specified requirements of BS 4987. This provides a durable surface but one which is not normally free-draining and this material has generally been superseded by porous tennis court macadam using either straight-run or modified bitumen binder.

1.1.1.2 Porous Macadam

During the 1970s ways were found of overcoming many of the shortcomings of British Standard bitumen macadam in respect to both the water retention at the surface and the softening resulting from having to use relatively "soft" penetration grade bitumens.

As a result of technological developments in both the inherent composition of the mixture and the types of bituminous binders that are available, the porous tennis court macadam that contains either a penetration grade binder or a modified binder has become the most popular material to be used.

A well-specified and properly constructed court of this type should be porous and frost resistant. A two-course construction of macadam binder course and surfacing course is strongly recommended.

Although, in some cases, the material would appear to be visually almost identical to the British Standard material, the macadam grading is refined by the reduction of the quantity of finer aggregate particles in the mix. This enables the drainage of surface water through the wearing course layer, thereby allowing play to resume more quickly after particularly heavy or prolonged precipitation.

In respect to the bitumen used, the mix does not contain cut-back oils and this has significantly lifted the temperature threshold at which the surface softens in hot weather. The absence of the oils also enables the surface to be colour-coated between two to three weeks after it is laid. To increase further the softening temperature threshold, the macadam can also be manufactured using bitumen that has been modified by the addition of a latex, wax or polymer. Sometimes the term "non-softening" has been used to describe this type of surface. This is, however, misleading, as all bitumen-bound surfaces soften to some extent in warm weather. The use of binder modifiers, such as latex or polymers, may increase the durability and softening threshold of porous macadam courts.

For all bitumen-bound surfaces detailed instructions, concerning the precautions that should be taken by the court user when the weather is warm, should be provided by the installer.

1.1.1.3 Coatings and Binders

The majority of porous macadam tennis courts are colour-coated with specially manufactured coatings that are spray applied to the macadam surface. The coating helps to define the play area in a bright, appealing way and influences the pace and slip resistance of the surface. It is important to remember that the painted coating forms the playing surface. If it is applied incorrectly the performance and durability of the court can suffer.

The use of binders has become popular in recent years. They are clear coatings that are applied to new or old macadam surfaces to provide enhanced strength to the playing surface. They also aid the adhesion of the paint coating to the macadam surface, acting as a form of tack coat. Binders are available in either water or solvent-based acrylic or polyurethane formulations and are spray applied.

Binders are considered particularly advantageous when applied to new courts that are:

- close to trees – the binders will help resist the effects of tree sap and bird droppings on the court surface;
- subjected to high levels of use or where non-tennis shoes are likely to be worn;
- subjected to prolonged periods of shade leading to damp areas;
- Used by wheelchair players.

On older macadam surfaces, where the original bitumen binder incorporated in the macadam mix has aged and noticeably started to weaken, the application of a binder coat may prolong the life of the macadam surface. On very weak macadam, however, the quantity of binder required to hold the surface together may be such that it seals or partly seals the surface resulting in a significant loss in porosity. As a rule of thumb, if an old court starts to break-up during power washing the level of deterioration is likely to be so great that an application of binder will not be effective, and resurfacing is therefore required.

As binders do not have any form of texturing agent in their formulation the resulting film coating will be slippery when wet or damp. If a binder coat is applied a court must also be colour-coated. Applying a binder will not improve the texture of the macadam surface. Heavily pitted macadam will still be heavily pitted after a binder coat is applied.

1.1.1.4 Selection of Paint Coatings and Binders

The choice of colour coating and binder product is critical if the court is to have 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; and
- 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.

Advantages:

- In most domestic and club situations this type of surface provides a good finish and a durable coating. The formulations have few health & safety concerns during application.

Disadvantages:

- In situations of heavy wear or abuse the coating may show signs of premature wear.
- If applied to medium or dense macadam (low permeability), prolonged exposure to moisture can cause softening of the paint film and rapid wear.
- The coating needs to be applied in dry warm conditions.

Solvent-Based Polyurethane Paint

These paints form a particularly hard-wearing and durable coating suited to areas of high use.

Advantages:

- They are supplied as a single-pack material requiring no mixing on site. The resulting coating is very hard and durable.
- High durability makes this type of coating suited to areas subjected to high use such as school courts, multi-use games areas (MUGAs) etc.
- They can be applied in less favourable weather conditions than water-based paints.
- As the coating does not soften when exposed to water, solvent-based polyurethane paints can be applied to slower-draining macadam bases.

Disadvantages:

- Some minor cracking of the macadam surface can occur due to the differential in the thermal expansion rates of macadam and the paint film. Great care needs to be taken to ensure that the correct amount of paint is applied to the macadam.
- Spraying on newly-laid macadam in the spring and autumn may increase the risk of cracking, as the temperature differential between day and night is greater.
- There are increasing concerns about the environmental effects of using a product that dries and cures through solvent evaporation and the potential impact on the atmosphere, operatives and neighbouring properties (particularly schools where young people may be playing nearby) means that the industry is moving away from this type of coating.

Water-Based Polyurethane Paint

These are paint coatings designed to have the benefits of solvent-based polyurethane but without the environmental disadvantages.

Advantages:

- Much improved durability over water-based acrylic paints.

Disadvantages:

- As with solvent-based polyurethane paint the incorrect application can cause cracking of the macadam.

Water-Based Acrylic / Polyurethane Blend Paints

These hybrid forms of coating are based on formulations containing polyurethane that is blended with acrylic (typically 15 to 20% polyurethane) to increase the durability of the water-based acrylics, whilst retaining the elasticity of the acrylic paint film.

Advantages:

- In most domestic and club situations this type of surface provides a good finish and a durable coating. The formulations have few health and safety concerns during application.
- Improved durability when compared to water-based acrylic paints.

Disadvantages:

- It is a relatively new development that is yet to withstand the test of time, nevertheless early indications are positive.
- In situations of heavy wear or abuse the coating may show signs of premature wear.
- If applied to medium or dense macadam, prolonged exposure to moisture may cause softening of the paint film and rapid wear.
- The coating needs to be applied in dry, warm conditions.

Water-Based Acrylic Binders

These are based on acrylic resins and are best applied to newly-laid macadam surfaces to complement the adhesion of the bitumen binder in the macadam mix.

Advantages:

- Increased strength of the macadam, to some extent, and improved paint adhesion to the surface.
- Flexibility of the film should accommodate thermal movement of the macadam.

Disadvantages:

- Does not improve the bond strength of the macadam to the same degree as polyurethane binders.

Solvent-Based Acrylic Binders

These are binders formed from blends of acrylic resins and solvents.

Advantages:

- They are similar in performance to water-based acrylic binders, but penetrate the surface further to improve bond strength. Although based on solvents these do not raise the same levels of environmental concerns within the industry as solvent-based polyurethanes.

Disadvantages:

- They do not improve the bond strength of the macadam to the same degree as polyurethane binders.
- They can be difficult to apply in some situations.

Solvent-Based Polyurethane Binders

These types of binders form a stronger and hardwearing film.

Advantages:

- Increases bond strength of the macadam (particularly a surface that is starting to fret) and improves paint adhesion to the macadam surface.

Disadvantages:

- If applied excessively some cracking of the macadam can occur due to the differential in thermal expansion rates of the macadam and the binder film. Spraying on newly-laid macadam in Spring or Autumn may increase the risk of cracking, as the temperature differential between day and night is greater.
- Contractors and users have expressed environmental concerns about using a product that dries and cures through solvent evaporation and the resulting potential impact on operatives, neighbouring properties and the atmosphere.

Although advice should be taken for each individual court project to ensure the correct types of paints and binders are used, the Table 2.1 shows the types of paints and binders commonly used on a variety of court types.

One of the main reasons for selecting a painted macadam court is that the surface is free-draining allowing use throughout most of the year. If a paint or binder coating is applied too thickly, (or a number of coatings are applied throughout the life of the surface), its ability to drain can be reduced to a point that will allow water to pond on the surface in wet periods. This encourages moss growth and potentially the softening of water-based coatings and premature abrasion. This situation should be avoided. The normal criterion for porous courts is that water should not be standing on a court surface fifteen minutes after rain ceases to fall. If the spraying contractor is unable or unwilling to confirm that this will be achieved then the viability of recoating should be assessed.

As a general rule a court surface can be coated (with binders and / or paint) three or possibly four times before a noticeable reduction in porosity occurs.

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Application	Type of paint				Type of binder		
	Water-based acrylic	Solvent-based polyurethane paint	Water-based polyurethane paint	Water-based acrylic / polyurethane blend	Water-based acrylic	Solvent-based acrylic	Solvent-based polyurethane
Residential court	1	4	3	1	not normally necessary		
Tennis court, club use, no floodlights	2	4	1	2	2	2	4
Tennis court, club use, with floodlights	2	3	1	2	2	2	2
School court (no control on foot wear)	4	3	1	4	2	2	2
Kids Zone	1	4	4	3	4	4	4
Netball court	4	3	1	4	2	2	2
Courts with significant wheelchair use	2	3	1	2	1	1	2
Courts under trees or shaded	Select from above				1	1	2
Old court starting to fret	Select from above				1	1	1

1	Recommended
2	Suitable
3	Suitable but not normally used
4	Not recommended

1.1.2 Artificial Grass

Artificial grass courts have been used over twenty five years and although problems were experienced with early courts, predominantly due to the misconception that they were maintenance free and all weather, they have gained acceptance and are now one of the most popular form of tennis court surfacing for club and recreational tennis.

1.1.3 Tufted Carpets

The vast majority are tufted carpets that are manufactured by looping the tufts into a woven mesh (primary backing) and then anchoring them in place by applying a backing compound (normally a latex screed). Drainage is provided by punching holes through the backing normally every 100mm. The pile of a sand filled artificial grass is quite flexible and is unable to stay vertical unless it is supported by a sand infill. The sand, of a specifically selected size and shape, is brushed into the pile to the top of the surface of the carpet. The carpet is laid directly onto a macadam base.

There are three generic types of artificial grass, long, medium, and short pile. Long pile was the original form and laid exclusively during the 1980's and early 1990's. Typical properties of this type of artificial grass surface are:

Pile height	18mm to 21mm
Pile density	Low (20,000 to 25,000 tufts m ²)
Typical sand infill rate	25kg/m ²
Surface pace	Fast to very fast with a low bounce (ITF Surface Pace ratings of 40+)
Comfort level	High
Routine maintenance requirements	High
Potential for sand movement (meaning courts may be considered slippery when dry)	High

Many of the negative attributes identified with long pile surfaces have been attributed to the sand infill - its ability to move as a result of normal play and the failure of clubs to regularly brush courts to maintain the sand levels. This led to manufacturers in the early 1990's developing artificial grass carpets with lower pile heights and greater stitch rates. These carpets are now commonly referred to as 'medium pile carpets'. Typical properties of this type of artificial grass surface are:

Pile height	15mm -18mm
Pile density	Medium (40,000 to 55,000 tufts m ²)
Typical sand infill rate	15kg/m ²
Surface pace	Fast to very fast with a quite a low bounce (ITF Surface Pace ratings of 40+)
Comfort level	High
Routine maintenance requirements	Medium high
Potential for sand movement	Moderate

In the mid-1990s manufacturers took the principle one stage further and developed 'short pile carpets'. These have subsequently become the most popular type of surface now being installed; winning favour from clubs, coaches and the LTA. The basic properties of this type of artificial grass surface are:

Pile height	10mm
Pile density	Medium to high 40,000 to 85,000 m ²
Typical sand infill rate	8kg/m ²
Surface pace	Medium slow to medium with a moderate bounce height (ITF Surface Pace ratings of 30 to 40)
Comfort level	Medium
Routine maintenance requirements	Medium
Potential for sand movement	Low

Surfaces with a pile density at the lower end of the range rely on the proven procedure of using sand to support the pile, providing of course that the sand levels are maintained correctly. Carpets with a high tuft rate primarily rely on the density of tufts to support themselves. Whilst this approach reduces the quantity and movement of sand it also makes it harder to prevent the sand from compacting and this can lead to drainage problems. In an attempt to minimise sand movement but ensure adequate long-term performance an increasing number of surfaces are now being introduced that have between 55,000 and 65,000 tufts per metre square.

The pile density of tufts does not seem to have a significant effect on the surface pace, although carpets with a low number of tufts per metre square are considered by some to be slow when new. Some products also use a curly yarn to form the pile. This type of pile does not generally offer the same resistance to the ball and the carpets have a similar surface pace rating to medium pile carpets (medium fast to fast). The use of alternative surface dressings (e.g. rubber crumb) will also allow manufacturers to adjust the playing characteristics of a surface.

Play lines are most commonly permanently marked onto courts. This is most commonly done by using either inlaid lines, tufted lines or a combination of both.

Inlaid lines are where a section of the parent roll of carpet is cut out and a line inserted. The line is manufactured in from the same carpet as the main court, just in a different colour. The section of carpet to be cut out from the parent roll should be cut out using use a double bladed knife set to the correct width. Having cut out the section the gap should be checked to ensure a good fit with the line. The line should then be bonded in place using the same procedure as that used to form other joints.

Tufted lines are incorporated into the main carpet during manufacturer. As carpet rolls are normally laid along the length of a court this makes it quite simple to incorporate the singles and doubles side markings. By laying rolls of carpet across the back of each court (a 90° to the main rolls) the baseline can also be tufted into the carpet. Due to the greater difficulties in manufacturing the service lines and centre tabs etc. are normally inlaid.

1.1.3.1 Needle Punch Surfaces

Sand filled needle punch surface were developed in the 1980s, initially as a multi-purpose sports surface for school use. As such it provides a durable surface that is more than capable of catering with the demands of most tennis clubs. Specialist tennis version have been available since the mid-1990s and provide a medium to medium fast surface with a degree of shock absorption that is greater than macadam and similar to many short pile artificial grasses.

The enhanced stability of the sand within the pile of the carpet means the surface requires less maintenance than sand filled artificial turfs and is less likely to be considered slippery in dry weather when loose sand can move to the surface of all types of sand filled surface. The enhanced stability does, however, allow moss to become established more readily in the surface and this can be a problem on sites surrounded by trees etc.

1.1.4 Acrylic

1.1.4.1 Impervious Acrylic

Acrylic, or “American Cement”, are terms used to describe a surface used throughout the tennis-playing world. Traditionally formed by multiple applications of coloured acrylic or resin materials laid on an impervious macadam or concrete base, the surface’s playing characteristics makes it suitable for all standards of play, up to the highest levels of competition (US and Australian Opens). The surface encourages and rewards good playing technique and so is also ideally suited for all levels of coaching and training.

The surface can be played on for twelve months of the year, depending on the weather conditions. The impervious nature of the surface does mean that on outdoor courts during periods of rainfall, surface water or puddles will form which will normally prevent play from continuing. Before play can recommence this must be cleared and can be achieved with the use of specific drying aids such as squeegees. The decision to install an impervious acrylic court therefore needs careful consideration.

The speed of the surface is controlled by texturing agents incorporated into the surface; the coarser the texturing agent the slower the pace of the court.

Another important consideration for anyone choosing an acrylic surface is cushioning. Cushioning can be provided in the form of in-situ laid rubber layers or preformed shockpads. Whilst most impervious acrylic surface systems offer different amounts of built in cushioning, all but the most cushioned (and therefore most expensive) are still relatively hard compared to the protection provided by modern tennis shoes. The shock absorbency properties of most thin layer cushioned systems are also temperature sensitive and may provide little improvement over non-cushioned courts for large parts of the year when laid outdoors.

Tight tolerances for surface levels and high standards of specification and workmanship are essential for the successful installation of these surfaces in the damp UK climate. Foundations must be strong, carefully compacted and protected from water ingress to prevent settlement or frost damage.

1.1.4.2 Porous Acrylics

A number of companies are starting to introduce surfacing systems that they describe as ‘porous acrylic’. Designed to replicate the playing characteristics of impervious acrylic but without the limitation of water ponding in wet weather these surfaces are proving to be successful in an increasing number of clubs. When considering these surfaces it is important that the playing characteristics are assessed and not the composition. Just because a surface is formed with acrylic polymers does not necessarily mean it will play like the traditional acrylic court surface.

1.1.5 Polymeric

A polymeric tennis surface is usually an elastomeric mixture of natural or synthetic rubber in a binder (matrix) of polyurethane. A polymeric surface may be cast in-situ or be supplied in prefabricated sheet form.

Polymeric courts can be constructed with either porous or impervious surfaces and have a degree of cushion providing a softer and more comfortable footing than the harder surfaces such as porous macadam. The surface plays with a medium to slow pace, is not affected by frost or ultra-violet attack and does not soften to cause problems in hot weather. Surfaces can be finished in a variety of colour combinations, can be played on throughout the year, and require low routine maintenance, although periodic recoating is required and is not an inexpensive item.

The base for a polymeric court is a conventionally engineered, macadam court which would be open-textured for a porous construction and dense for an impervious surface. Porous concrete is also a suitable base for porous polymeric surfaces.

1.1.6 Clay Surfaces

1.1.6.1 Traditional Clay Surfaces

Clay is a term used to describe a porous water-bound tennis surface material consisting of natural crushed stone, brick, tile or combination of these. The traditional types of clay typically seen are French Clay (Terre Battue), as used at Roland Garros, Continental or European clay as used in much of Western Europe and shale or blaes as used in the UK.

For the last few years the LTA has promoted American Clay courts. These were developed in the USA in the 1930s to be a surface that had similar playing characteristics to European clay but was less weather sensitive and required reduced maintenance programmes. The surface consists of a conventional free draining base of crushed stone with a surfacing material produced from a metamorphosed igneous basalt rock. This particular type of volcanic rock, which is green in colour, is extremely hard and when crushed forms an angular aggregate.

Clay surfaces produce a very distinctive style of play, involving sliding, slow pace and long rallies. The sliding qualities and pace can vary from one type of clay surface to another depending on the surface dressing.

Clay surfaces have required watering prior to play, and skilled ground staff are required to maintain them. During the winter months the rain and frost often make them unplayable for many weeks or months.

1.1.6.2 Synthetic Clay Surfaces

An increasing number of surfaces are being introduced to the market that are designed to have the playing qualities of clay but without the climatic limitations and demands for high levels of maintenance. Primarily, but not exclusively, based on some form of synthetic turf or textile carpet they are dressed with a variety of material including traditional clays, rubber granules and coated sands.

Player feedback on some of the products has been very positive to date and these types of surface are seen as an existing new development for the tennis court industry. In terms of construction most are based on similar base constructions to artificial grass surfaces, only the top surfacing really differing.

1.1.7 Performance Testing Of Tennis Surfaces

Over the last 20 years an increasing number of sports have started to assess the performance of the surfaces on which they are played by using a variety of specialist testing procedures. Tennis is no exception and in 1997 the International Tennis Federation published its initial guide to performance testing - the document currently being under review. In 2000 the ITF advanced the concept of performance testing one stage further and launched their Surface Pace Classification Scheme (for details visit their website on www.itftennis.com) - a formal assessment of a surface's pace using a standardised testing procedure. Many of the test methods detailed by the ITF have also been included in harmonised European Standards, now being published as British Standards, for sports surfaces.

The primary methods of test that may be applied to tennis court surfaces are described below. All of the tests may be used on laboratory samples to demonstrate acceptable performance in advance of installation of onsite to assess the performance of an installed surface.

1.1.7.1 Surface Pace

This test is described in ITF test procedure CS/01/01 and BS EN 13865. It utilises a sophisticated piece of test equipment that monitors the position of a tennis ball before and after it strikes a surface at a defined velocity and angle. By calculating the loss in the ball's horizontal and vertical speed as a result of the impact with the court a value known as the Surface Pace Rating is derived; the higher the number the faster the surface. The ITF have established a classification for surface paces; this has three bands.

Table 1.2 ITF classifications for surface paces.

Surface Pace range	Classification
0 – 35	Slow
30 – 45	Medium / medium fast
40 +	Fast

Table 1.2 – ITF Surface Pace Classification

For certain surface types the Surface Pace is a function of the surface and there is little a manufacturer can do to influence it i.e. porous macadam will always have a medium slow pace due to the open profile required to allow drainage. For other surfaces adjusting the profile of the surface allows the manufacturer to offer a range of surface paces e.g. acrylic surfaces can range from around 25 to 50.

Due to the nature of most surfaces a degree of variation in pace is inevitable. On clay and grass courts this varies day by day whilst on other surfaces types it increases as courts wear.

1.1.7.2 Slip Resistance

The slip resistance of macadam, polymeric and acrylic courts can be measured using a skid resistance pendulum mounted with a rubber test foot. The test procedure is described in ITF test procedure CS/02/01 and BS EN 13036 Part 4 using the CEN rubber test foot.

1.1.7.3 Shock Absorption

The shock absorption of many forms of sports surface are measured using the test procedure described in European Standard BS EN 14808. Whilst this test can be used on surfaces that provide degrees of cushioning over 10% (the test measures the reduction in peak impact force of the sports surface and compares it to concrete; the impact force and magnitude being designed to replicate an athlete running on the surface), its suitability to quantify the performance of thin surfaces that provide low degrees of shock absorption is currently under investigation by the International Tennis Federation.

1.1.7.4 Water Permeability

The rate at which water drains through porous surfaces can be measured using a double ring infiltrometer as described in BS EN 12616.

1.2 Professional Expertise

Whilst a tennis court may appear to only be a simple macadam construction with a synthetic or painted surface the exacting demands and tolerances of the game mean that they are best built by companies with the relevant and proven construction expertise. Likewise, bodies with specialist expertise are best to undertake the design, specification and project/construction management of a tennis court development. You should make checks on the experience of the contractor and designers you are selecting. All SAPCA members are examined to ensure they have the necessary experience, financial standing and proven quality of workmanship to undertake construction work.

Proper quality assurance procedures should be applied throughout construction; certain components of a synthetic surfacing system will be factory-prefabricated, whilst others may be manufactured in-situ from complex chemical mixtures, the properties of which can be influenced by faulty workmanship, defective materials or adverse weather conditions. In every case, it is advisable to check that the physical properties of each component of the system conform to the anticipated values and are obliged to undertake site works in accordance with the following requirements.

2 Section Two – Construction Guidelines

2.1 Site Considerations

Selecting the correct site for a court is a major factor in determining not only the costs of construction, but also the quality of the playing experience and the maintenance needs of the court. Where possible the location of a tennis court should be sympathetic to its surroundings and adjacent infrastructures. Ideally it will be sited on relatively flat land that is not too close to boundaries or trees. To reduce the chances of planning difficulties it is normally advisable to locate a court (especially floodlit ones) at least 12m, and ideally at least 30m from other residences. Access should be easy for players (including disabled players) and maintenance and construction equipment (all courts will require resurfacing at some point; a factor often overlooked when future developments take place).

As most new court developments will require planning consent advice should be sought at an early stage from the Local Planning Authority to determine whether any restrictions or conditions are likely to be required for the scheme.

As compliance with the Disability Discrimination Act is like to an obligation for most clubs, schools and other organisations providing courts for community use consideration should be given during the design stages of a project as to how disabled players will be able to use the organisation's courts.

2.2 Dimensions

A tennis court comprises the area within the play lines which is called the Principal Play Area (PPA) and the surrounds or run-offs. The *Rules of Tennis* define the size of the PPA; this is 23.77m x 10.97m. To ensure a satisfactory playing area adequate run-offs are also needed.

For club and tournament play the ITF and LTA has established recommended and minimum run-offs. For a single court the recommended run-offs are 6.40m at each end and 3.66m on either side. This gives a total court area of 36.57m x 18.29m.

In acknowledging that not all sites are large enough to accommodate the recommended court sizes, the LTA has also established minimum sizes that allow for shorter run-backs and side-runs. These dimensions are 5.49m at both ends and 3.05m on each side; this gives an overall court of 34.75m x 17.07m.

When courts of the same surface type are laid side by side it is possible to share the side-run between adjacent courts meaning a smaller overall width is required. Common side-runs should be between 4.27m (LTA recommended) and 3.66m (LTA minimum).

For private courts a minimum size of 33.53m x 16.45m is sometimes used, although better players may find the runback somewhat restricted.

Table 2.1 shows the overall court sizes for single and multiple court blocks.

	Type		
	LTA Recommended	LTA Minimum	Private Courts
Single court (s)	36.57m x 18.29m	34.75m x 17.07m	33.53m x 16.45m
Two courts common side run	36.57m x 33.53m	34.75m x 31.70m	
Three courts common side run	36.57m x 48.78m	34.75m x 46.33m	
Four courts common side run	36.57m x 64.01m	34.75m x 60.96m	

Table 2.1 – Court sizes

Whenever possible, particularly on sloping ground, the proposed site of the court should be large enough to allow an additional area of approximately 1m around the perimeter of the court in addition to providing for any banks resulting from any site levelling. Where site topography or cost implications preclude this, requirements for excavation and drainage must be properly met.

2.3 Orientation

It is recommended that tennis courts be orientated approximately in a north-south direction. This orientation preferred because it minimises the effect of a setting sun on the players, but in the UK climate, the inability to achieve this orientation need not preclude the construction of the court. It is also worth noting that where a court is built primarily with daytime play a north-south orientation may be far from ideal in the winter months.

2.4 Ground Conditions

The cost of a court is greatly influenced by site conditions. Costs will be much higher for engineering a difficult site, and it should be recognised that some sites are not cost effective to develop. A designer should consider a number of factors including topography, access, site drainage, trees and in particular ground conditions.

Before starting the detailed design, the designer will require as much information as possible about the site and its surroundings. Allowing sufficient resources for initial information gathering greatly reduces the risk of unforeseen problems, (and increased costs), during, construction or even later. Whilst on many sites an experienced contractor will be able to assess the requirements of the ground, on more complex projects a specialist geotechnical survey is often the best way of ensuring a full understanding of the site is established.

2.5 Trees

Trees may have the advantage of providing privacy, shelter or screening from a low sun. Their roots, however, can constitute a threat to the court itself (by distorting or cracking of the surface), especially strong-rooted varieties such as poplar, sycamore and willow. Where such a threat exists, preventative action will be necessary such as tree surgery and/or the construction of a root trench to inhibit the ingress of tree roots onto the tennis court site. This is usually done by digging a trench, cutting any roots in the process and removing them as far as possible to a depth of 500mm. The wall of the trench is then lined with suitable material, such as root control sheeting or concrete, before backfilling.

Note:

It should be noted that whilst such measures will inhibit root incursion, the only certain preventative measure is repositioning of the tree itself, generally to a distance equivalent at least to the potential height of the tree.

Branches that overhang a court are usually a cause of various problems, such as the continuous dripping of water, insect secretions and bird droppings. These can result in loss of paint, impaired porosity and fretting of the surface. It is strongly recommended that overhanging branches be pruned back or the court re-sited.

2.6 Services

When selecting the site for a court consideration should be given to the services that may be required to support the facility. Many sites will require some form of drainage; where is the water collected by the drains to go? Is there a suitable storm water sewer, ditch or other outlet that can be used? Is the natural ground suitable for a soakaway?

If the court is to be floodlit, now or in the future, where will the power for the lighting be taken from? Will the laying of cables require ducting under paved areas? Is lighting likely to be continuous with neighbours and therefore possibly the local planning authority?

2.7 Construction Guidelines

Most forms of tennis court, other than clay and natural grass, have similar base constructions and only differ in terms of the final playing surface and the supporting layer on which it is laid. The principal elements of a court are shown in Figure 1.

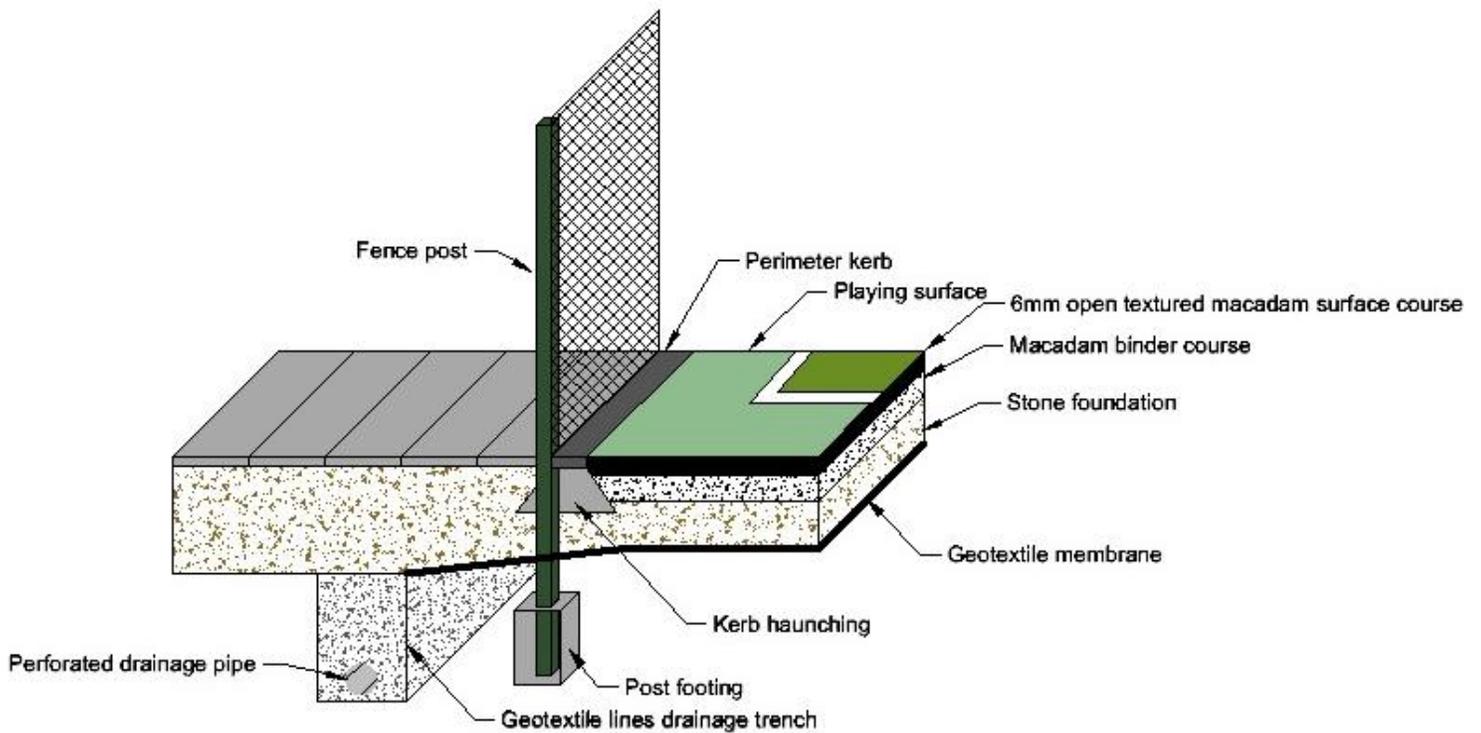


Figure 1 – Typical cross section of court construction

They comprise:

- the formation; this is the prepared natural ground on which the court is built;
- the sub-base; carefully graded aggregates that are laid to provide load bearing and stability for the playing surface and to protect, as far as possible, the formation from the effects of rain and frost;
- Macadam base; bitumen bound aggregate that forms the base on which the playing surface is laid or in the case of macadam courts forms the playing surface.

2.8 Excavations

Turf, vegetation and topsoil should be removed to a depth of at least 75mm. If greater depth of topsoil is present containing significant quantities of vegetable or organic matter then all such soil should be removed.

Excavations to achieve the required gradients are normally carried out on the “cut and fill” principle, i.e. excavating in the higher areas and using the resulting excavated material to fill the lower areas. When using this method all filling should be carried out in layers not exceeding 150mm, each layer being thoroughly compacted.

When excavating the site by “cutting to the solid” excavated material is removed from the area of the works and not reused. Any filling that may be necessary should be achieved by the use of selected, suitable material, which can be readily compacted and will not be subject to future settlement.

The formation should be fully compacted and accurately levelled to a tolerance of +25mm/-50mm and should provide a stable base for the foundation layer. Any soft spots that are evident should be removed and back-filled with appropriate material as described above.

Tree roots should be removed during excavation and the resulting holes from these or other underground obstructions should be carefully backfilled with suitable material as described above.

The gradient of excavated or filled banks should not exceed the angle of slope suitable for the excavated material (rarely more than 1:2). Should limitations of space dictate steeper angles and/or reduced shoulders at the top of banks, then suitable support should be provided such as retaining walls or buttressing.

2.9 Weed Killing

The site of the court should be treated with an appropriate herbicide following the manufacturer’s recommended dosage rate and method of application. This operation should be carried out by fully qualified personnel.

It is not possible to guarantee either to kill all weeds, or that no re-growth will occur after construction. To attempt to do so would necessitate the use of herbicides of such toxicity, or in such quantity, as to constitute a danger to humans and to wildlife. Some weed growth may sometimes occur but this usually represents little more than a temporary inconvenience.

If weeds appear on finished surfaces, they should not be pulled out but treated immediately with weed killer, allowed to die and then removed.

2.10 Drainage

Drainage from a court’s playing surface is provided, depending on the surface type, by surface run-off, percolation through the construction or a combination of the two.

2.10.1 Surface Gradients

To a degree there is a conflict between a slope to aid surface run-off and players' desires for flat courts. This has resulted in the maximum recommended surface gradient for porous courts being set at 1:120 and a gradient of between 1:120 and 1:100 being recommended for impervious constructions.

Surface gradients should, ideally, be across the court, but may also be from end to end or diagonal. Individual facilities should be designed according to the number, type and layout of courts, and the topography of the site. Falls must always be in a single plane, as any other arrangement (e.g. a camber or a fall towards each end from the net), effectively alters the height of the net and is therefore not acceptable. Subject always to local surface levels being within the tolerances recommended it is further recommended that the surface within the principal playing area should be within +/- 25mm of the theoretical true plane.

2.10.2 Sub-Court Drainage

Unless ground conditions are very bad, drains under a court are usually unnecessary and undesirable. Perimeter drains located just outside the perimeter edging are necessary on poorly draining sites. Porous foundations should be constructed so as to allow egress of water into the perimeter drain.

Catch water drains should always be installed wherever there is a danger of water flowing onto the court from surrounding areas. They are particularly important at the foot of cut banks formed during the levelling operation. In these locations the perimeter drain, backfilled with clean stone to the surface, may also serve as the catch water drain. Proprietary catch water drainage systems may be appropriate for intercepting water running off impervious surfaces.

Drains should consist of agricultural clay or perforated plastic pipes, laid in the bottom of well-formed trenches, backfilled with clean, graded stone aggregate or similar suitable material. Drains should be laid to falls of not less than 1:200 and be connected to soakaways or ditches well clear of the court area.

In certain sub-soils where the silting-up of drains may occur, the drain trenches should be lined with a geotextile or backfilled with a filter medium such as suitable sand.

Catch water drain trenches should be filled with the drainage material to the surface.

2.10.3 Impervious Courts

Impervious courts rely entirely on surface run-off for drainage. This is normally achieved by a combination of natural drainage due to the slope on the court and the physical removal of water by squeegees. It is therefore essential that suitable provision is made to take the water away from the edge of the court. Whilst this can be achieved by the installation of a French drain these tend to silt up with time and become less effective. The loose stone is also a potential source for vandals and can cause damage to the playing surface if allowed to migrate onto the court. It is therefore recommended that a proprietary catch water drain be installed along the lower side(s) of the court. If the courts is constructed with a fall in its length it is also permissible to install a catch water drain across the court under the net, provided that it does not exceed 150mm in width, is finished flush with the surface, incorporates a grill or similar and is not visibly intrusive.

2.11 Perimeter Edging

The court construction needs to be retained around the perimeter of the court. This is normally done by perimeter concrete kerbs, pavers or other firm edge restraint, such as a brick wall. Brick and concrete kerbs may be laid, either flat or on edge.

Care should be taken to ensure that the kerb, together with its concrete or mortar bed, does not prevent the flow of water out of the court foundation or from the court surface.

Edgings, when raised above the playing surface, should not constitute a hazard to the players. Similarly the gap between the edging and the perimeter fence should not be wide enough to form a foot trap point; a maximum gap of 10mm is recommended.

Within the design constraints of the site, edgings should not cause balls to excessively rebound back into the playing area.

2.12 Base Foundations

A well-engineered foundation is just as essential to the performance and durability of a tennis court as to any other structure. Failure to provide a suitable foundation may result in severe undulations, cracking or premature breakup of the playing surface.

The court will be subjected to many different stresses throughout the years and during the varying seasons and climatic conditions that occur. These stresses mainly concern the sub-soil on which the foundation 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:

- The site conditions e.g. climatic conditions and the type of sub-soil present;
- The 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 construction.

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Frost Heave is caused when frost penetrates into susceptible sub-soils that include a lot of fine silt like 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.

Foundations should be constructed using hard, clean, well-bound, non-frost-susceptible aggregates. These are typically a reduced fines grading of the Department of Transport Type 1 aggregate mix or a 28mm to 50mm clean stone capped with a 10mm chipping to as a blinding.

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.

The minimum accepted design depths (subject to the tolerances detailed in this code of practice) are:

Foundation:	150mm consolidated for porous playing surfaces and 200mm for impervious playing surfaces
Macadam binder course	40mm compacted depth
Macadam surface course	25mm compacted depth

This gives a total minimum construction depth of 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 cost of courts and most clients 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 totally 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 2.2 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 take into account specific site information and local knowledge. If in doubt it is recommended that specialist expertise be sought.

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Table 2.2 gives the design depths of the foundation level for each soil type

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 +

Table 2.2 – recommended foundation depths

The figures given in Table 2.2 show the design depths for any particular 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 court should the foundation depth be 25mm below the design depth and that the total area of a court (or court block) on which the depth is 10% below the design depth should not exceed 10% of the total area. This means that on a court designed with a foundation depth of 150mm the minimum depth should be 125mm and no more than 10% of foundation should have a consolidated depth below 135mm.

When existing courts are to be resurfaced or reconstructed, care must be taken to ensure that any old ash, clinker etc. that is to be retained is assessed and deemed fit for its intended purpose, i.e. it does not impair the drainage or cause problems in frosty weather. These materials are normally found to be of a medium to high frost risk and are treated as a sandy/gravelly silt or clay material in accordance with Table 2.2.

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.

2.13 Floodlighting Ducts

If it is intended to install floodlighting either immediately or at some time in the future, it may be necessary to install ducts to carry the cables, either within or immediately beneath the court foundations, to avoid future disturbance of the court surface.

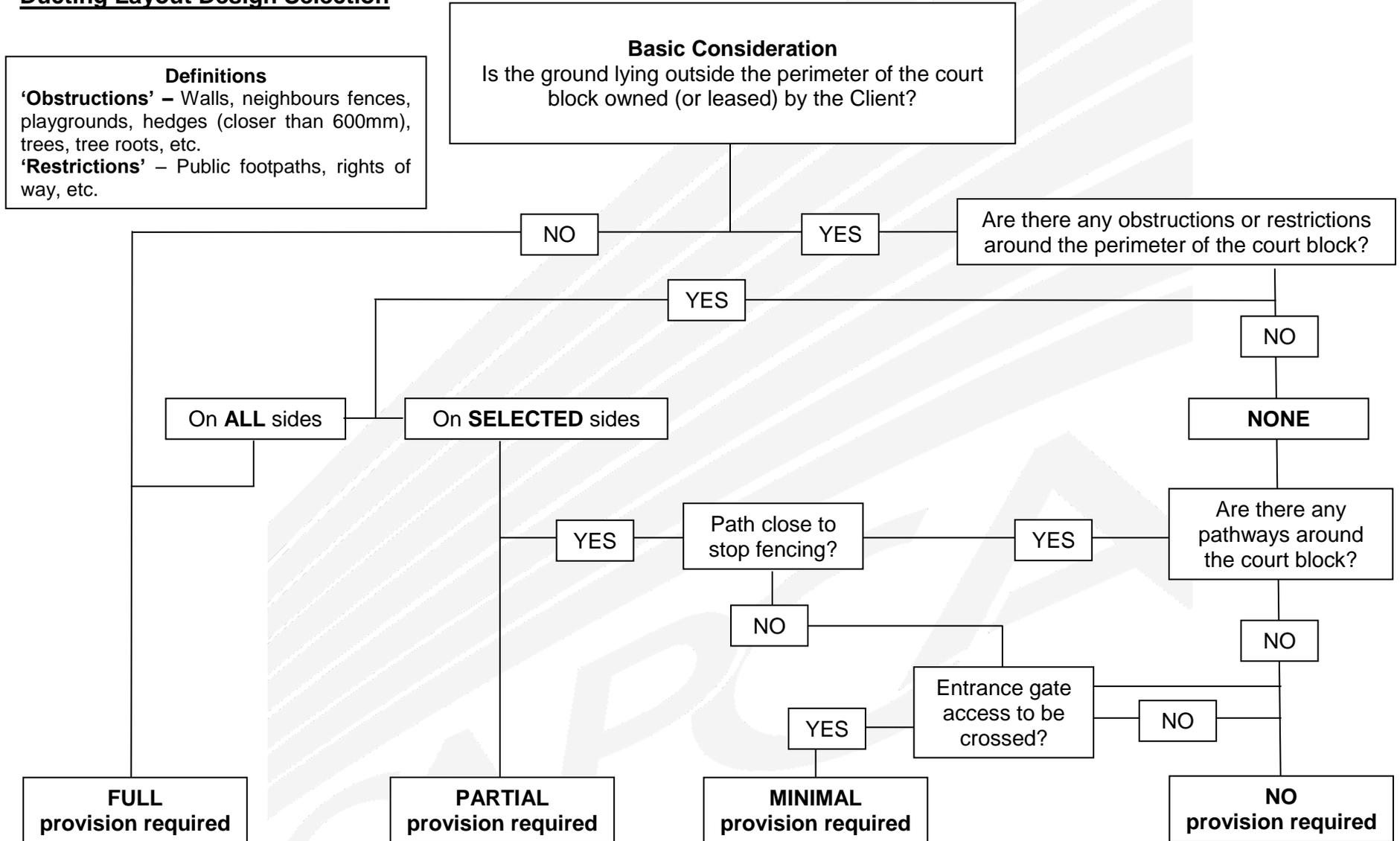
Ducting normally takes the form of either a minimal, partial or full system, depending on the layout of the courts and surrounding structures. The flow chart on the next page is designed to help decide which is most appropriate for any particular site.

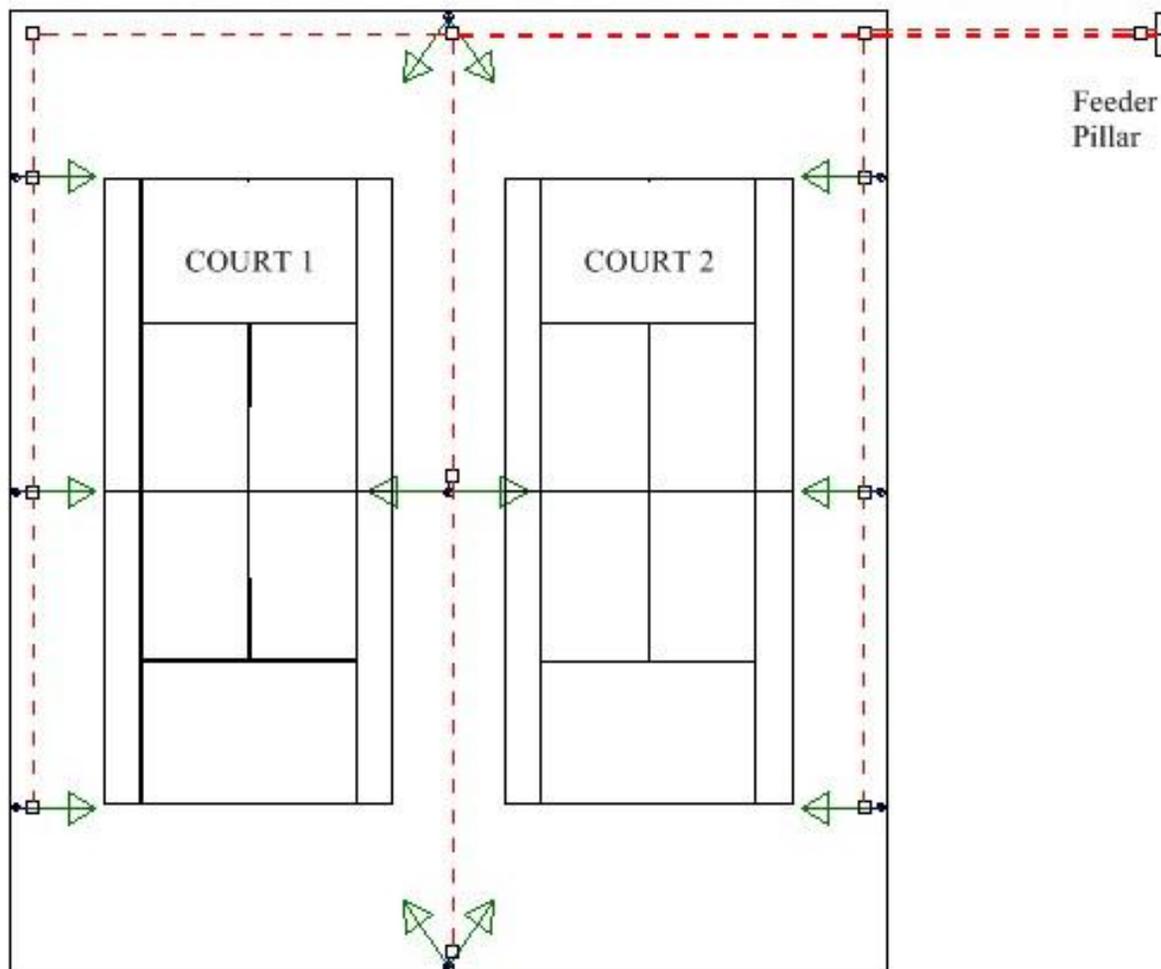
Once the appropriate layout has been selected a ducting and draw-pit design may be developed. Examples of each type are shown on the pages following the flow chart.

Ducting is normally formed from plastic piping, normally 100mm or 150mm in diameter, depending on the number of cables. It is normally installed at a depth of at least 450mm

Draw-pits are installed to allow the future cabling and re-cabling of the lighting columns. Draw pits are normally pre-fabricated plastic sections that link together to form the chamber. The cover of the draw-pits should finish flush with the playing surface or macadam base as appropriate. When forming part of the playing surface the draw-pit should be recessed to allow the playing surface to be installed within it to minimise the impact of the playing surface.

Ducting Layout Design Selection





Full Provision
Duct - drawpit layout

Key & Notes

Cable duct 50mm minimum 450mm deep 750mm across roads

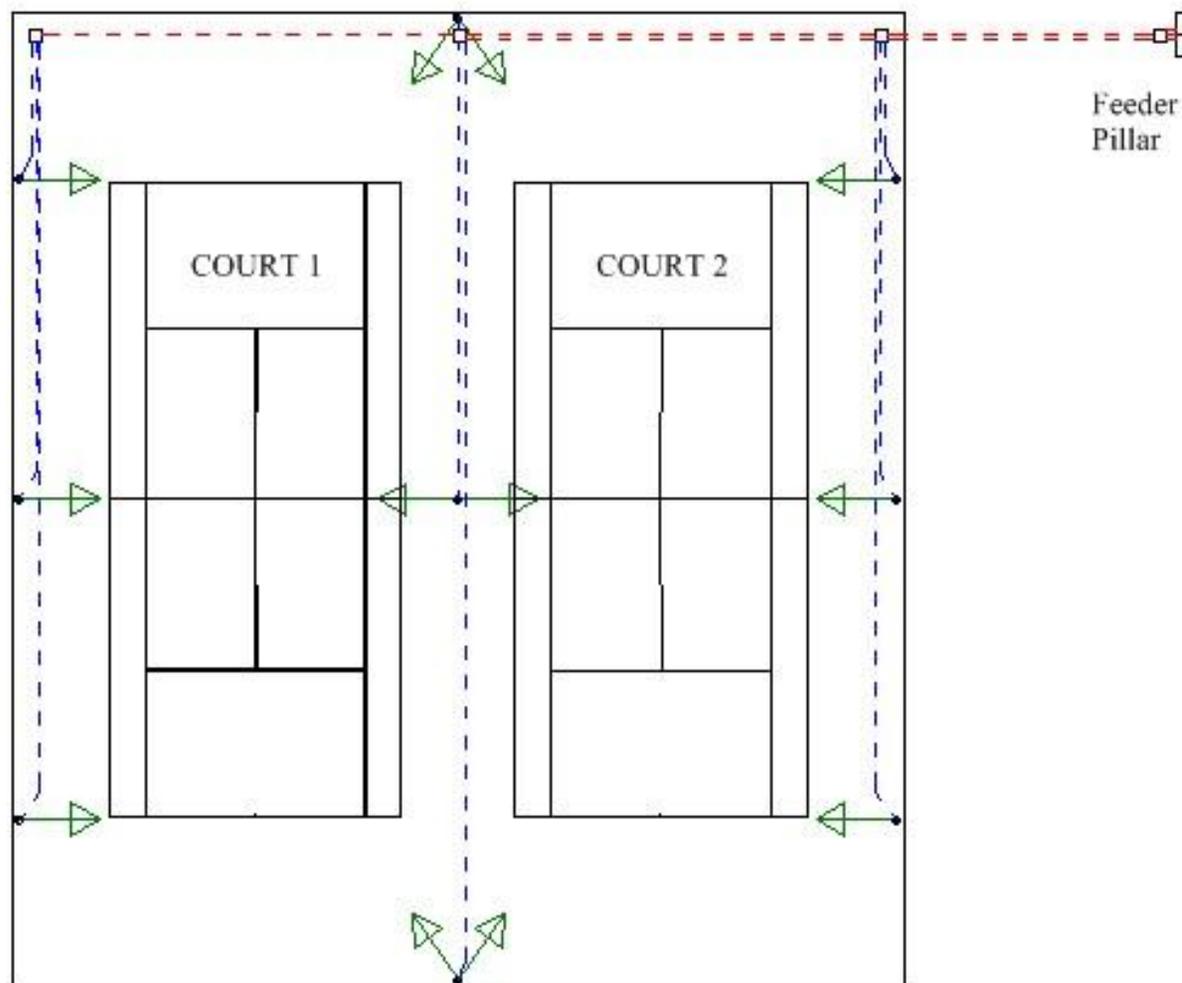
Cable duct 110mm minimum 450mm deep 750mm across roads

Cable duct 150mm minimum 450mm deep 750mm across roads

Cable trench, sand filled with warning tape, minimum 450mm deep 750 across roads

→ Column and luminaire

□ Drawpit 450 x 450mm



[Full Provision](#)
[Duct - drawpit layout](#)

Key & Notes

Cable duct 50mm minimum 450mm deep 750mm across roads

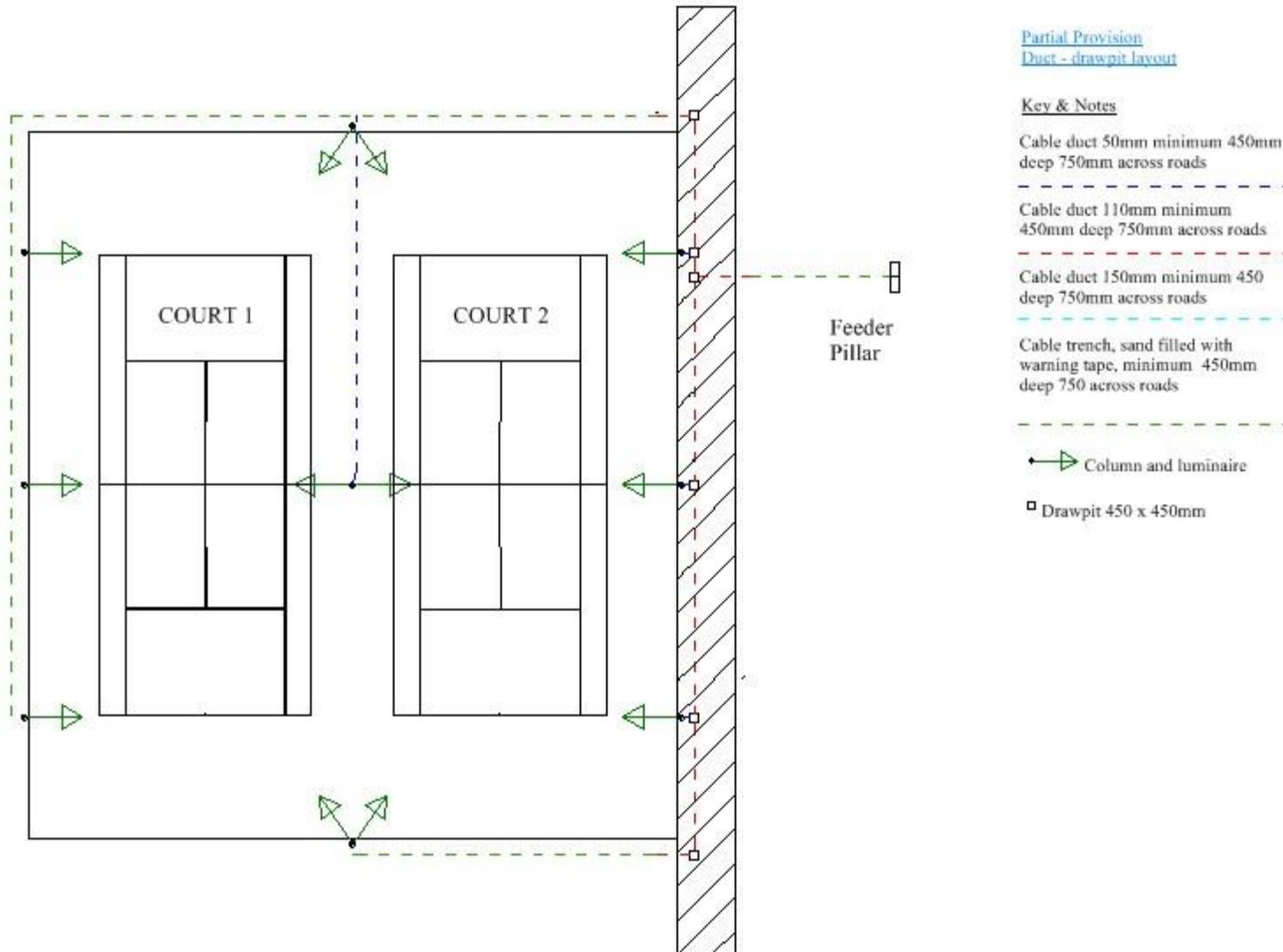
Cable duct 110mm minimum 450mm deep 750mm across roads

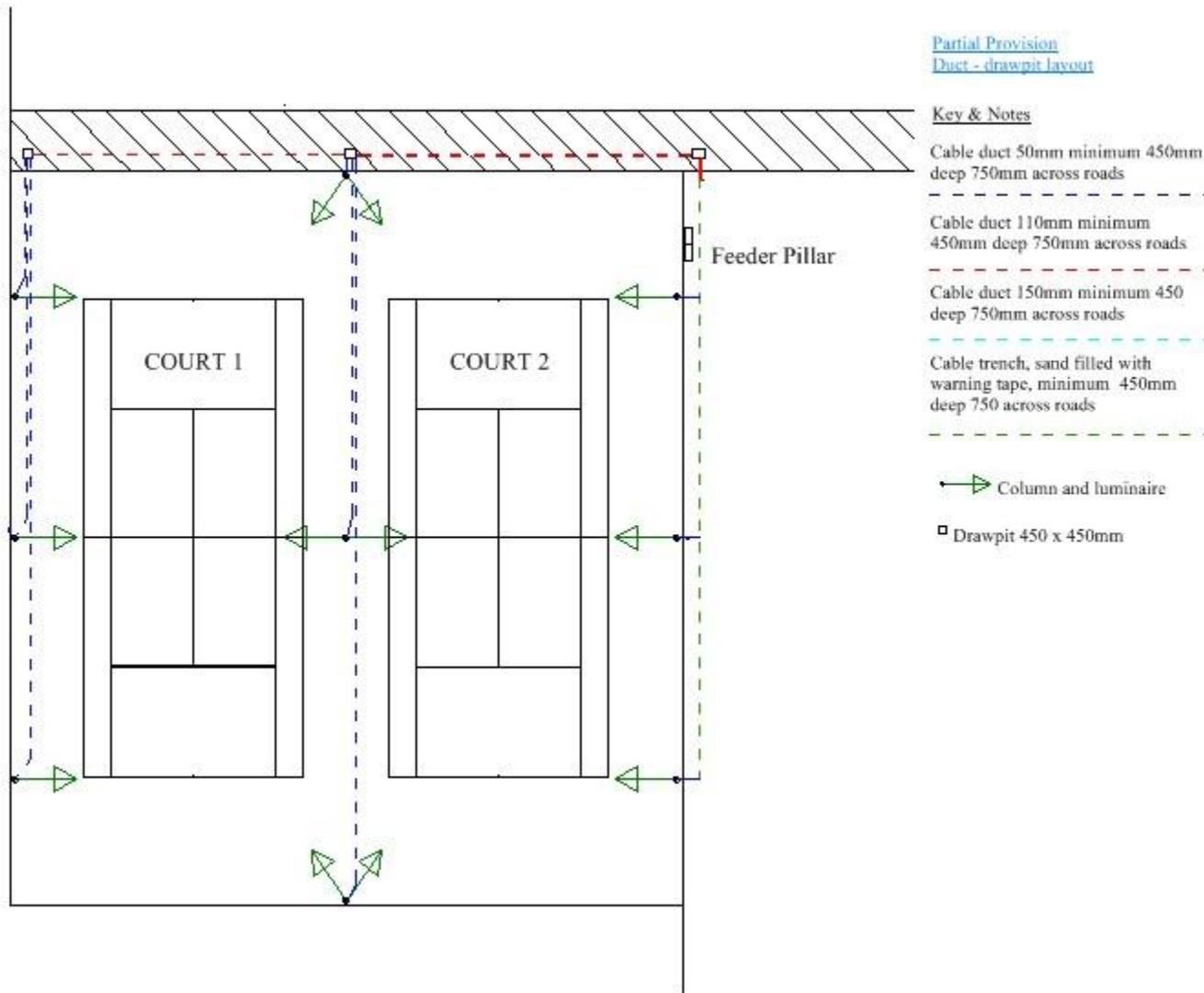
Cable duct 150mm minimum 450mm deep 750mm across roads

Cable trench, sand filled with warning tape, minimum 450mm deep 750 across roads

→ Column and luminaire

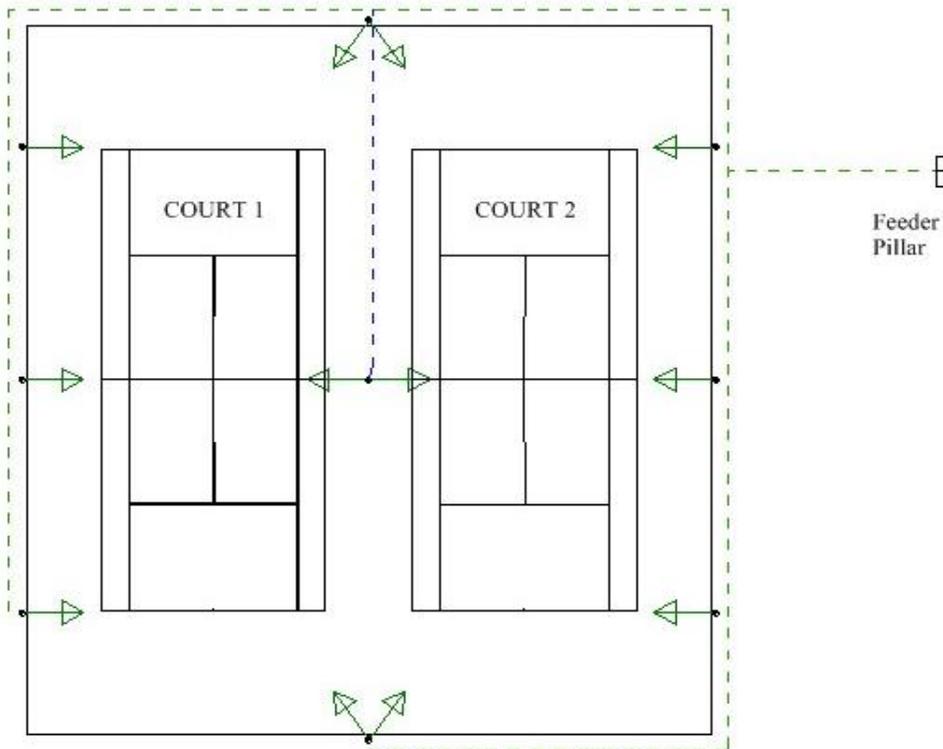
□ Drawpit 450 x 450mm





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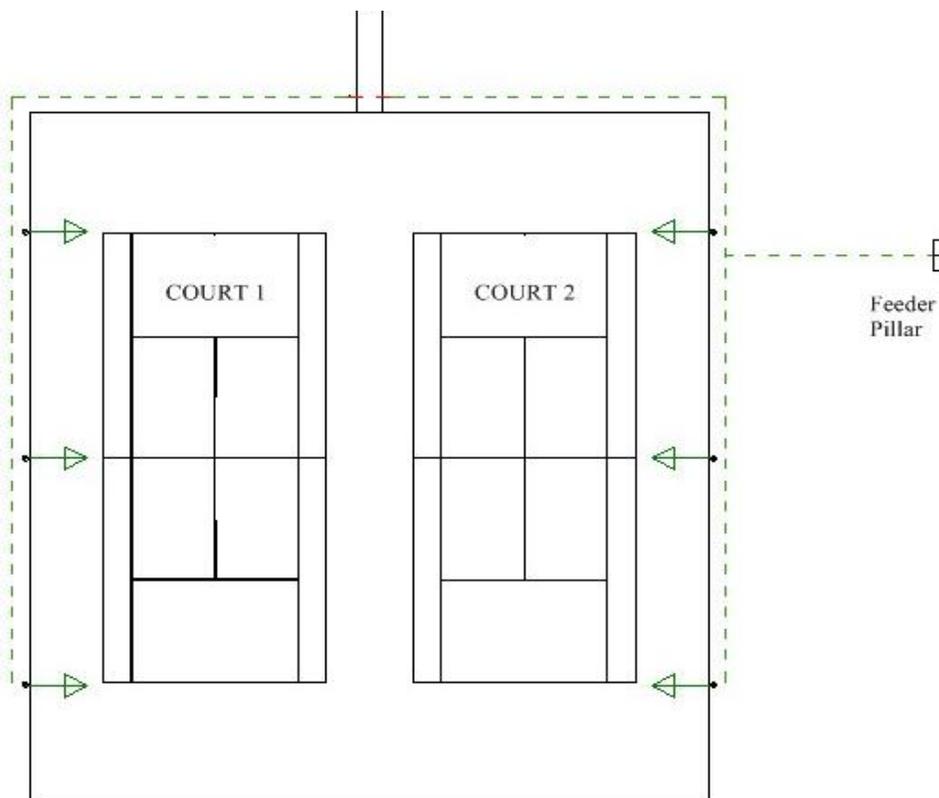
[Minimal Provision](#)
[Duct - drawpit layout](#)



Key & Notes

- Cable duct 50mm minimum 450mm deep 750mm across roads
-
- Cable duct 110mm minimum 450mm deep 750mm across roads
-
- Cable duct 150mm minimum 450 deep 750mm across roads
-
- Cable trench, sand filled with warning tape, minimum 450mm deep 750 across roads
-
- Column and luminaire
- Drawpit 450 x 450mm

[Minimal Provision](#)
[Duct - drawpit layout](#)



Key & Notes

- Cable duct 50mm minimum 450mm deep 750mm across roads
-
- Cable duct 110mm minimum 450mm deep 750mm across roads
-
- Cable duct 150mm minimum 450 deep 750mm across roads
-
- Cable trench, sand filled with warning tape, minimum 450mm deep 750 across roads
-
- Column and luminaire
- Drawpit 450 x 450mm

2.14 Macadam Surfaces and Bases

2.14.1 General

Macadam is laid over the foundation. This may form the playing surface or the platform on which a form of synthetic surface or coating is laid. Most commonly the macadam is laid in two courses, a binder course (previously called a base course) followed by a surface course (previously called a wearing course). A nominal compacted depth of 65mm is recommended, comprising:

- a binder course of 40mm depth of 10mm, 14mm or 20mm open-graded macadam for porous courts or dense macadam for impervious courts
- a surface course of 25mm depth of either 6mm or 10mm (depending on the playing surface type) of open-graded macadam for porous courts and dense macadam for impervious courts

Where, for budget reasons, a single layer macadam construction is used it must be laid on a fully stable and well-compacted foundation, and comprise a minimum consolidated depth at any point of 25mm of 6mm open grade macadam. Experience has shown that this type of construction is only suitable for courts subjected to light use. As such most external funding organisations do not consider this type of construction suitable for club, public, school or college courts.

Tennis court owners expect a macadam tennis court to have:

- An even surface of reasonably uniform texture;
- A durable surface which is not prone to early-life fretting or aggregate breakdown;
- A surface through which water will drain reasonably quickly;
- A surface that does not soften unduly in hot weather.

To achieve these objectives in a newly constructed macadam tennis court, it is necessary for the overall court design and construction to be satisfactory and for the macadam to be of uniform quality and laid satisfactorily. Each of these aspects is fundamental to the successful performance of the court. For example, texture, porosity and durability can be as much influenced by the achievement of adequate compaction during laying as by the properties of the macadam mix itself. It is therefore strongly recommended that a macadam binder course be used in the construction of all courts.

The service life of a macadam tennis court depends on many factors including the method of construction, quality of drainage, extent of use and the care and maintenance given to the court. It is, therefore, not possible to give firm indications of service life. However, provided that the recommended maintenance schedule is followed, which will include the clearance of surface debris and, perhaps, line paint renewal, a court that has been well constructed to good standards, such as those indicated in this Code of Practice, should be serviceable for a period of five years or more.

Thereafter, timely application of surface maintenance treatments before significant deterioration of the surface has occurred will considerably extend the service life of the court. Maintenance requirements are detailed in Section Five.

Coated macadam courts are composed of mineral aggregate particles bound together with a bitumen binder. The main properties of a macadam mix that influence its performance on a tennis court are: its texture and porosity - which are influenced by aggregate grading and consistency of grading; its durability - influenced mainly by the aggregate strength and the binder content of the mix; and its resistance to softening - influenced by binder type and grade.

The guidance on these properties given in the following text covers British Standard macadam surfaces as well as porous macadam surfaces. However, for the compositional requirements of British Standard macadam surfaces, which are not covered in this section, reference should be made to the current edition of BS 4987.

2.14.2 Binder Course

The use of a macadam binder course is fundamental to enhancing the performance and extending the serviceable life of a tennis court. The purpose of a macadam binder course is to provide a stable, well-shaped platform to receive the surface course. Open-graded binder course mixtures with low fines content offer good workability during laying, with the additional benefit after compaction of providing a high voids content free-draining layer. A bituminous binder course enhances the contractor's ability to meet the dimensional tolerances required of the surface course, and minimises textural variations. The stable binder course platform provides the best opportunity to enable compaction of the surface course to be achieved, thus providing a uniformly porous and durable surface.

For the binder course, a 0/14mm size open-graded macadam mix having a target grading within the parameters given in BS 4987 for a 14mm size open-graded surface course, is recommended. A minimum binder content of 3.5% (with a production tolerance of $\pm 0.5\%$ applied to the value) is likely to be satisfactory.

Where hand screeding is used to lay the material, a 0/10mm size open-graded surface course can be used laid to the same recommended thickness as the 14mm size material. In applications where the construction demands an increase in the macadam binder course layer thickness, a 20mm size open-graded binder course can be used.

Recommendations for the layer thicknesses, laying and compaction are contained within Table 2.5. For both these mixes, the supplier will select the target grading from within the parameters given in BS 4987.

Whichever mix is chosen, the supplier will select an appropriate binder content for the type of aggregate used. A bitumen grade of 190/220 penetration is generally recommended, and the grade used should be no softer than 250/300 penetration.

To reduce the risk of the surface course material softening, through the entrapment of volatile oils, the use of cutback or deferred set binders should be avoided.

2.14.3 Surface Course

On courts on which the macadam surface course is to be the playing surface a 0/6mm grade is used. This is normally an open textured grade of macadam although medium grades may be used where structural strength is the overriding consideration, although it must be appreciated that the ability of a medium grade macadam to allow water to drain through the surface is much less than an open grade and in many cases is best described as semi-porous.

2.14.3.1 Texture

Specifications for coated macadam courts include tolerances on the aggregate grading to allow for normal production variations. This will mean that minor variations in texture between different loads of macadam might be apparent in the laid material. However, provided the macadam complies with the required composition specification, its performance should be satisfactory as long as it is well laid and compacted.

Macadam courts 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 tennis court.

The question of what is an acceptable texture can be contentious as many clients fear that an area of macadam 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 affect the way a ball rebounds from the surface? If it does not it is probably acceptable.

2.14.3.2 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 recognised, however, that it is not always possible to completely eliminate weaker aggregate particles. There will, therefore, be the occasional appearance of such weaker aggregate particles in a macadam 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 court surface, is controlled by the use of 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 macadam 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.

2.14.3.3 Porosity

For the macadam 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 macadam.

Note:

Because of surface tension between fresh bitumen and water, drainage of water through the porous tennis court surface can be slow during the very early life of the court. 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.

As different aggregates have different packing properties that will influence the void content of the laid mix, individual macadam suppliers have developed gradings for their particular aggregates to achieve good drainage properties for tennis court macadam's. However as a guide a typical "tennis court topping" will be a 0/6mm size open-graded macadam with a target grading set within the limits given in Table 2.3. To ensure consistency of drainage properties as well as surface texture, the tolerances shown in Table 2.4 shall be applied to the target values of the supplier's proposed specification.

Table 2.3 shows the limits for each grading of macadam

BS test sieve	Percentage by mass passing	
10mm	100	
6.3mm	90 – 100	
4mm	35 - 50	± 10%
2mm	15 - 30	± 7%
1mm	5 - 20	± 5%
0,063 mm	0 - 6	± 2%
Binder: Minimum 4.5 %		

Table 2.3 - typical target aggregate grading range 0/6mm macadam surface

Table 2.4 shows the target tolerance for the supplier

Binder	± 0.5%
Table 2.4 – target values tolerances for supplier's proposed mix	

Subject to correct aftercare and maintenance, a macadam surface of this type should provide acceptable surface water drainage for a number of 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.

2.14.3.4 Mix Durability

As long as adequate binder content is used in the macadam 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 particular aggregate type and on the target grading employed. Suppliers will consider all these factors in order to ensure a durable mix.

2.14.3.5 Resistance to Softening

Softening of a coated macadam tennis court surface in hot weather is one of the most common sources of customer dissatisfaction. All coated macadam 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, macadam laid in a "sun trap" position will be more prone to softening problems than one laid in a shaded area. Also, macadam 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 bitumens need to be used in the macadam 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 macadam must be kept to a minimum.

2.14.4 Transport and Material Handling

Coated macadam's 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 weather-proof 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.

2.14.5 Laying and Compaction

For a porous macadam surface, the macadam binder course and surface course shall be laid at the nominal compacted thicknesses recommended in Table 2.5. At no point in the construction shall the layer thickness be less than the minimum compacted thickness, which is also stated within Table 2.5.

Compaction is the most critical operation in the construction of any bituminous surface, especially those incorporating macadam's. 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 2.6). 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 2.6 includes the grades of binder and types of additive most 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.

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Table 2.5 gives the nominal compacted thicknesses of the macadam binder course and surface course.

Material	Two course (recommended)		One course (only recommended for courts subjected to light use)	
	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	28 mm	25 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	-	-

Table 2.5 – macadam thicknesses

Table 2.6 provides the minimum specified rolling temperature to compact the macadam layer

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

Table 2.6 – recommended macadam laying temperatures

The laid thickness of the bituminous material directly affects the rate at which cooling occurs: 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 2.5.

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 compactive force.

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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 2.7 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 2.6, to compact fully a bituminous layer of up to 50mm thickness.

Table 2.7 gives the minimum number of roller passes required by roller type to fully compact a bituminous layer up to a thickness of 50mm.

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
Greater than 2,000 Kg/m	Twin drum vibratory	3

Table 2.7 – number of compaction passes required by roller type

2.15 Playing Surfaces – General Requirements

The correct installation of the playing surface is essential if a court is to provide a satisfactory playing environment and meet player's expectations. As the range of surfaces used by tennis is large different requirements and construction limitations apply, depending on the type of surface being installed.

2.15.1 Regularity or Evenness

The surface regularity of a newly-built or resurfaced tennis court should conform to the following:

At no point within the play lines should there be any bump, hollow, ridge, joint or textural variation sufficient to cause reasonable expectation that a ball in play might be deflected from its true path.

Subject always to (a) the surface should be laid to a tolerance in accordance with Table 2.8.

A certain number of deviations (of up to 4mm) are permitted from the tolerances shall be as shown in Table 2.8 providing when measured under a 1m straightedge, the deviation does not exceed the tolerances stated in Table 2.8 for the maximum gap beneath a 3m straightedge. Deviations over 1000mm in length are to be considered to be multiple deviations (e.g. a 1.8m long ridge is considered to be two deviations one of 1m length and one of 0.8m length).

Table 2.8 provides the allowed tolerances for checking the surface level using a 3m straightedge.

Surface Type	Maximum gap	Max. number of permissible deviations	
		PPA	TPA
Macadam – two or more layers	8mm	4	8
Macadam – single layer	10mm	4	8
Artificial grass on two or more layers of macadam	6mm	2	4
Artificial grass on single macadam layer	8mm	4	8
Impervious acrylic	6mm	4	8
Porous acrylic	6mm	2	4
Polymeric	6mm	2	4

Table 2.8 – maximum permitted undulation under 3m straight edge

PPA = Principal Playing Area – for the purposes of surface regularity this is defined as the area within the court markings a distance of 1m behind the base line at either end of the court.

TPA = Total playing area of court as defined in note (i) below and includes PPA.

Notes:

Regularity should be measured in accordance with BS EN 13036 Part 7 by placing a 3m straightedge at any position on the surface of the court (excluding a 1m wide strip around the perimeter of the court and around court fittings such as net posts), and measuring the gap at any place between the points at which the straightedge is in contact with the surface.

The variation in allowable tolerances in Table 2.8 reflects the relative difficulty of achieving superior surface levels with certain types of surface and construction, such as single layer macadam.

2.15.2 Porosity

Porous surfaces when newly laid (but after an initial period of weathering) should be free draining and can be expected to be clear of surface ponding within fifteen minutes of rain ceasing. BS EN 12616 defines a method of test for assessing the water infiltration rate of sports surfaces. A minimum of rate of 100mm/h is normally specified.

As the surface ages its porosity will gradually decline, as a result of contamination with dirt, vegetable matter, fluff from tennis balls etc. The maintenance guidelines in Section Five should be followed in order to limit this decline.

Note:

Immediately after construction, some bitumen macadam and other surfaces may retain water on the surface as a result of surface tension. This is a temporary phenomenon and should not be construed as a defect. The same may occur after a prolonged dry spell.

2.15.3 Surface Texture

Tennis court 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 in order 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 macadam. Such variations are acceptable providing that they are not so severe as to affect significantly the playing characteristics, porosity or strength of the surface, and providing that the appearance of the court is not unreasonably impaired.

2.15.4 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.

2.15.5 Initial Settling Down Period

Most tennis court 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.

2.15.6 Corrective/Remedial Action

Some surfaces, most notably macadam, 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 closely match adjoining areas in colour, texture and levels and, except where invisible mending can be achieved, (e.g. with clay or some artificial grass surfaces), should be replaced to the nearest play lines, net-line or construction joints. Joints should be neat, straight and unobtrusive.

2.16 Paint Coatings and Binders for Macadam Courts

2.16.1 Macadam Curing

If a court is painted before the bitumen incorporated in the macadam 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.

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.

When repainting existing courts, moss, weeds and ingrained dirt should be removed, first by chemical treatment and then by high-pressure washing. As excess pressure can damage the surface, this work should always be undertaken by skilled operatives or after taking advice from the contractor that built the court.

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 distance 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.

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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 macadam 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 actually 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.

The application of paint or binders is by airless spray technique. Pressures will depend on many factors but will typically be between 2,500 and 5,500 psi. The tip size should be carefully selected to ensure correct atomisation of the coating (28 thou. being typical) and the spray fan should be uniform with a feathered edge so that there are minimal discernible lines on the painted surface.

Two coats of paint should be applied in different directions to ensure an even finish with no patches. On Kids Zones three coats of paint are normally required to produce the vivid colours required.

Paint and binder coatings should be mixed according to the manufacturer's instructions and applied at the recommended application rates.

Some paints are supplied ready for spraying whilst others require dilution on site. It is essential that paints should be diluted at the rates specified by the manufacturer, as excessive dilution will cause premature failure of the paint film.

When a binder has been applied it is important that the colour coating should be applied before the binder has dried fully, to ensure good bonding between the coatings.

As a guide, typical application rates are detailed in Table 2.9. The ranges take into account the varying sizes of tennis and netball court areas.

To allow the coating to cure fully, it is recommended that courts are left for at least three days, and ideally five, depending on the conditions after coating and before play commences. The contractor's advice should always be sought and followed to ensure that damage to the coating does not occur.

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Table 2.9 gives the volume of product required to cover a new macadam court

Product type	New macadam court (litres) *
Water-based acrylic paint	170 – 200
Acrylic / polyurethane blended paint	170 – 200
Water-based polyurethane paint	160 – 180
Solvent-based polyurethane paint	150 – 175
Water-based acrylic binder	80 – 100
Solvent-based acrylic binder	80 – 100
Solvent-based polyurethane binder	60 – 80
* The actual quantity of paint required will depend on the size of the court. The ranges details are based on the LTA 's minimum and recommended court sizes	

Table 2.9 - coating applications

Lines may be applied using a variety of application methods such as spray, brush or roller, using an acrylic or polyurethane line paint of similar specification to that used to coat the court.

The line markings should be in accordance with the rules of the appropriate sport. Where the rules of the sport do not detail tolerances for the accuracy of the markings the lines should be within 20mm of the specified dimension. Straight lines should not deviate by more than 10mm from a line joining their ends, nor include any sudden steps.

All lines should be bright, straight and have a sharp, defined edge.

As lines form part of the playing area they should also satisfy the slip resistance criteria for the court. It is for this reason that the use of aerosol paint cans for permanent lines is not recommended due to the low values of slip resistance usually achieved, and their poor durability.

Existing line markings should be checked for accuracy in terms of compliance with LTA and ITF rules before repainting. Where they are found to be inaccurate the courts should be remarked accurately in accordance with the Rules of Tennis, following consultation with the client.

2.16.2 Specific Considerations for Kids Zones

The painting of Kids Zones requires a great deal of skill. Experience has shown that consideration of the paint and court materials, weather conditions and attention to detail are just some factors that can influence the success of the coating process.

The bright, coloured paint used for Kids Zones contains liquid pigments that do not cover as well as the concentrated powder pigments used on standard courts. It is therefore very important that the coatings should be applied consistently as any unevenness in the application technique will clearly show as a variation in the depth of colour. Problems of even application are made worse by the very small areas to be coated. Care must be taken to avoid applying excessive paint around the perimeters of the areas and minimum spraying pressures should be used to apply the coatings and to avoid drift. To minimise the risk of drifting and over-spraying coatings should only be applied in still conditions.

Macadam, particularly newly-laid, will expand and contract with changes in temperature. If the coating applied to the surface does not have adequate elasticity it can restrict the movement and cause the surface to craze or crack. Over-painting to mask drifting or overlapping of paint (and lines) can result in thick rigid films that cause stress fractures of the macadam surface. For this reason masking of areas must be undertaken to minimise drifting. This does, however, increase both the time required to paint a Kids Zone and therefore the costs involved.

As polyurethane paints form a more rigid paint film than acrylic paints they are less able to accommodate the thermal movement of the macadam, particularly if the coating is applied too thickly. The use of polyurethane paints on Kids Zones is not therefore recommended. Kids Zones should only be painted with acrylic paints.

2.16.3 Slip Resistance

The paint used to coat the macadam forms the playing surface and the correct choice is critical if an acceptable and durable playing surface is to be provided. When a coating is applied it reduces the friction of the macadam surface. If the reduction is too great the court can become slippery and hazardous in damp and wet conditions.

To control the reduction in friction, paint manufacturers incorporate texturing agents such as silica or aluminium oxide in the paint formulations. These are designed to provide a textured finish to the paint coating that, in conjunction with the inherent texture of the macadam surface, provides adequate grip in dry, wet and damp conditions.

The level of slip resistance properties of the paint coating is primarily influenced by the size of particle used to form the texturing agent. The larger the particle, the rougher the coating and therefore the higher the slip resistance. Whilst high slip resistance may initially be considered desirable this is not always the case. If the slip resistance is too high players of some sports, particularly tennis, may object to excessive grip that causes difficulties in turning, especially in dry conditions. Excess wear of the felt covering of tennis balls will also result. Sports such as netball, however, actually require high grip in order to give players the confidence they need to move and stop according to the way the sport is played. This means that different sports have different requirements for the coatings.

It is important to appreciate that the level of grip required for netball will result in quite an abrasive finish to the court surface.

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The paint film encapsulates the texturing agent. The rate at which the texturing agent wears and becomes smooth will influence how long the court has an acceptable level of slip resistance. The rate of wear is influenced by many factors including:

- the type of footwear used on the court;
- the frequency the court is cleaned and debris is removed;
- the amount of usage;
- the formulation of the coating – water-based coatings can soften if exposed to moisture for prolonged periods making the coating more prone to wear;
- the size of particle used to form the texturing agent – larger particles tend to break away and wear more rapidly than small ones.

Whilst the use of paints with a texturing agent has overcome many of the problems of slippery courts that used to be associated with painted macadam courts, there is a limit to their ability to provide high levels of grip in damp conditions, particularly after drizzle or heavy dew.

The friction or slip resistance of the playing surface is measured using the test procedure described in BS EN 13036 Part 4 (a similar test is also described by the International Tennis Federation in their *Initial ITF Study on Performance Standards for Tennis Court Surfaces*). The measuring device consists of a pendulum and rubber foot that is allowed to slide across the court surface. The resistance to the foot sliding across the surface is recorded and expressed as a measure of slip resistance.

To ensure that a newly-painted court has adequate slip resistance it should satisfy the following criteria when assessed in accordance with test method BS EN 13036 Part 4 using the CEN rubber test foot. The criteria should be met when the court surface is dry or wet.

Table 2.10 gives the minimum value of slip resistance for the different court use.

Primary sports use	Minimum value of slip resistance
Tennis	60
Mini-tennis & Kids Zones	60
Netball	75

Table 2.10 - slip resistance of painted courts

Wet test areas should be made on a test area that has been watered at a nominal rate of 50 l/m² before being allowed to drain for two minutes. The test should then be carried out within the following three minutes.

Subject to the correct maintenance being undertaken, the court surface should satisfy the criteria for slip resistance for at least twelve months following painting.

2.16.4 Maintenance and Care of Coatings

An acceptable performance from coatings may typically be expected for three or four years if the court is used for its intended purpose and maintained correctly. Circumstances where the paint coating may wear prematurely include the following.

- The use of the court in warm or hot weather during the first season after laying.
- The use of inappropriate footwear such as hard soled shoes - the correct sports or tennis shoes should always be worn.
- Allowing the court to be used for activities such as football, cricket, hockey, golf, skateboarding, roller-blading and cycling.
- A lack of routine maintenance.
- The use of inappropriate cleaning equipment and the incorrect type of high-pressure hoses, etc.
- The use of the court as a general playground.
- Allowing vehicles onto the court.
- The spillage of fluids, including fuels, solvents and some fizzy drinks.

2.17 Artificial Grass

2.17.1 General

The range of artificial grass surfaces is large and the many different types have a variety of differing playing qualities. This means it is not possible to establish a comprehensive specification for the quality of the carpet that all products will achieve. Nevertheless all surfaces should be able to satisfy the requirements of Table 2.11.

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Table 2.11 gives the guideline requirements and the test methods used to obtain each property of the surface.

Property	Test method	Guideline requirement
Polymer	DSC	UV stabilised polypropylene or polyolefin
Pile detex		6,660 or 8,800
Tuft withdrawal force	ISO 4919	>25N
Permeability	BS EN 12616	> 100mm/h
Joint strength	BS EN 12228	> 25N/100mm

Table 2.11 - general properties for artificial grass tennis surfaces

2.17.2 Weather Considerations

Artificial grass surfaces can only be laid in certain weather conditions. This is because of 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 the conditions 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 surface in less than ideal conditions just to complete the work on time.

2.17.3 Base Preparation

If the court is a new construction it should be built to satisfy the necessary drainage, stability and regularity requirements for artificial grass courts.

If an existing court is being converted or resurfaced some preparatory works are likely to be required. The base on which the new carpet is to be laid should be checked for regularity and drainage. If only localised areas are found to be out of tolerance for surface regularity, these can be rectified by localised patching or planing. If a significant number of area are out of tolerance overlaying with a new macadam surfacing course is normally the most cost effective approach.

When laying a new macadam layer the edgings of the court should be raised to contain the new layer of macadam and to prevent wind getting under the synthetic grass carpet and lifting it (the carpets are loose laid).

If the drainage of the base is found to be unacceptable it will need piercing to improve. Piecing involves punching holes through the macadam surface to form a drainage link to the sub-base and underlying ground. The holes, typically 25mm diameter, are back filled with chippings or pea gravel.

Piercing the base will, however, result in small holes and there is a possibility that these holes will reflect through to the new playing surface. If this occurs, the aesthetics of the court can be damaged and, more importantly, ball rebound may be unpredictable as a result of the ball striking the edges of holes. The risk of holes affecting the ball is greatest on a short pile carpet due to the lower pile height but it has been known to occur on medium pile carpets. The only way of ensuring that the holes do not affect the way a court plays or appears is by over laying the pierced base with a new layer of porous macadam. It is recommended that a new macadam layer be laid on pierced courts on which a short pile carpet is being laid and it is desirable for medium pile carpets as well.

2.17.4 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 checking the roll 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 there 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 centred 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.

Two types of adhesive are commonly used. Polyurethane adhesives are supplied as two-part components that should be mixed in accordance with the manufacturer's instructions and applied to the carrier tape using a notched trowel to give the recommended coverage. Hot melt adhesives are applied using a glue gun that heats and melts the adhesive allowing it to be applied to the carrier tape prior to application of the carpet. Once cured the joint should have seam strength of greater than 25N/100mm when tested in accordance with BS EN 12228.

2.17.5 Sand Application

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 in order 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. Only drive with care over previously sanded areas. 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.

2.18 Impervious Acrylic Surfaces

2.18.1 Preparation of Macadam or Concrete Base

Tolerances for surface regularity are given in Table 2.8 of this Code of Practice. A client should be made aware of these as their expectations may be different and they should understand that regardless of how accurate a base and surface is laid, there will always be some degree of water retention after rain – a 1mm deep hollow will allow a puddle to form.

Deviations from the tolerances should be located by dragging a straight edge across the surface and low areas measured and marked. These areas should be filled with an appropriate levelling compound. These compounds should be supplied by the surface manufacturer and come in various forms with different names but usually comprise a liquid resin that is mixed with sand and cement, or sometimes a powder is supplied with the liquid. The mixing and application instructions should be followed when filling the depressions, which can be done with a plasterer's trowel or straight edge. Care should be taken not to apply this compound thicker than the maximum depth given by the manufacturer. Some deeper depressions may require a second application after the first one has set. This compound should also be trowelled over any areas of rough or open macadam often found at the joints.

Concrete sub-bases may have expansion joints which can be filled with a similar compound, again supplied by the surface manufacturer, however due to the movement at these joints; it is likely that a hairline crack will later appear. For this reason the joints are often positioned, wherever possible, beneath court lines to lessen the visual effect.

After the necessary drying time, these areas should be smoothed over with a rotary sanding machine. Even quite small "nibs" must be removed as over a number of coats to follow the effect of small imperfections builds up and it is always most economical to spend time achieving a smooth surface at this stage as the work required later is multiplied many times.

2.18.2 Surfacing Layers

The first layer to be applied over a macadam base is usually referred to as Resurfacer but some manufacturers may use names like "Filler Coat" or "Base Coat". It is designed to seal the pores of the macadam and provide a strong, even surface as economically as possible. The colour may not be the same as final colour as it is not necessary to achieve the final colour at this stage. It is often necessary to apply more than one layer of Resurfacer depending on how rough the texture of the macadam is.

Solid concrete surfaces should be treated with a solution of diluted Phosphoric Acid (or Hydrochloric Acid) to neutralise the PH and ensure that gas is not generated when moisture subsequently penetrates through the surface after rain. After acid treatment the surface should be hosed off before further coatings are applied. A concrete primer should then be applied to allow a strong chemical adhesion of the subsequent acrylic layers. These primers come in various forms and should be supplied by the surface manufacturer. They are usually applied by squeegee, roller, broom or airless spray.

2.18.3 Cushion Coats

Various degrees of cushioning may be incorporated into the surface by incorporating layers of bound rubber granules or prefabricated sheet materials. The performance of the cushioning will vary and is primarily influenced by the types and thickness of materials laid.

2.18.4 Coloured Layers

The name given to these layers and the number of layers required varies depending on the manufacturer, they consist of a binder (commonly acrylic) mixed with fine sand (less than the amount in Resurfacer) and a little water. Often the sand quantity is reduced as the layers are applied and some acrylic systems specify no sand in the final coat. The customer should be made aware that the choice of system, and amount of sand used in these layers, will affect the overall surface pace and slip resistance.

The colours are selected by the customer and can be applied as either a single uniform colour across the whole surface or as "two-tone" where the playing areas are a different colour to the surrounds.

2.18.5 Weather Considerations

All of the water-based products made for these systems are limited to being applied within certain temperatures (usually between about 12°C and 40°C ambient temperature, 7°C and 50°C surface temperature). The drying times vary tremendously depending on temperature, sunlight and air movement, but generally only one coat of any product should be applied per day unless conditions are optimum. Application should never commence when rainfall is imminent.

2.18.6 Mixing

All products should be mixed following the manufacturers mixing guidelines and ratios. Some materials are supplied premixed requiring only the addition of water on site whereas others require the addition of sand or other texturing additives as well as water. Thorough mixing is essential with all types of material.

The mixed material is normally transported on to the court area in buckets or taken on a trolley in larger drums. If a trolley is used and the Acrylic surface is being laid over new dense macadam the trolley tyres should be pneumatic so as to prevent depressions being made in the macadam.

2.18.7 Application

Prior to application the kerbs surrounding the court and net post sockets should be protected with masking tape or similar.

The surfacing material may be applied by roller, sprayer or a "squeegee" (rubber bladed paddle) depending on the manufacturer's recommended method of application.

It is very important that only a thin and even coat of surfacing material is applied for each layer. Excessive material application in any one layer can result in premature curing on the top surface and inadequate curing of the lower material in the layer. This can prevent full and even evaporation of water from the layer which can often result in "blistering" appearing on the

finished surface. There is a far greater likelihood of uneven/partial curing resulting in blistering when the material is applied in more extreme temperatures or if or an unexpected shower occurs during application.

After each layer is completed, thoroughly dry and cured, any ridges, nibs or lumps should be removed before starting the next layer. This can be done by using a scraper, sanding block or rotary sanding machine depending on the nature and extent of the defects. Thorough and careful preparation work in between layers is vital for a good surface finish.

It is more difficult to scrape or sand off any defects that appear on the cushion layers due to the rubbery nature of the material. It is advisable, therefore, to apply these layers as smoothly as possible.

Immediately before applying each layer in the Acrylic system the dust from the preparation work and any other loose debris should be removed from the surface. This can be done by sweeping but is very time consuming on large areas. An ideal tool is a leaf blower provided extreme care is taken if using a petrol driven machine to prevent any fuel spillage on the court surface.

It is not unusual for water-based acrylic paint applied with a squeegee to have a slight "streaky" appearance when dried. Provided the material has been correctly mixed and applied, minor visible "streaks" will have no detrimental effect upon performance nor durability, only on the aesthetic appearance of the facility.

Playing lines should be applied using an acrylic/resin "finish" layer material in white (or other line colour chosen) supplied with the same degree of texture to ensure compatibility and even performance across the court surface. Lines are normally applied by brush or roller, usually between parallel masking tape, to ensure clean, crisp lines.

Acrylic courts are renowned for their consistency. Whilst small variations in Surface Pace are inevitable these should not be excessive. On new courts a tolerance of ± 4 of the desired Surface Pace value is currently considered realistic.

2.19 Porous Acrylics

Due to the differing types of materials used to form the playing surfaces of porous acrylic courts it is not possible to give general guidance on how they should be installed. All are, however, laid on a porous macadam base and this should be constructed in accordance with the relevant sections of this Code of Practice.

2.20 Polymeric Surfaces

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 a macadam base or supplied in factory produced rolls that are bonded to a macadam 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: 2006.

Due to the weather sensitivity of this type of surface quality control sampling is often undertaken when the surface is installed. During each day the surfacing is laid the Contractor will prepare a sample measuring at least 300mm by 300mm; the thickness and compaction of the material being representative of the materials installed on the court. The samples are left adjacent to the court for at least 48 hours before being sent for testing to determine the thickness and tensile properties of the samples.

2.21 Tennis Nets and Posts

Most courts have socketed posts. Courts used for other activities or prone to vandalism may have free standing or portable posts that are removed after play.

Tennis nets and posts should comply with BS EN 1510. Tennis post sockets should be set in concrete bases of a minimum 750mm x 750mm x 600mm deep. The centres of the posts should be 0.914m (3') outside the court (i.e., the outside tramline), on each side. Centre band ground anchors should be set in concrete bases of a minimum of 300mm x 300mm x 300mm deep.

A recessed socket or anchor should be inserted flush with the surface at the centre of the net to secure the adjustable centre-band.

Tennis nets should always be slackened when play has finished, too prevent undue strain on the posts and the net cable.

2.22 Surround Fencing

Tennis courts are normally enclosed with some form of fencing. This is to act as a ball stop, to protect the court surface and in many cases to prevent unauthorized access onto the court. Comprehensive guidance and specifications for fencing is given in SAPCA's Code of Practice for the Construction and Installation of Sports Facility Fencing.

Surround fences are usually constructed using steel posts of angle, tubular or hollow square section. The most widely used is angle section mild steel, usually of a minimum size of 45mm x 45mm x 5mm for intermediate posts and 60mm x 60mm x 6mm for corner and straining posts. The use of tubular posts and top rails are becoming increasingly common. This type of fence is structurally stronger.

All steelwork should be galvanised or zinc coated and may be coated with a bitumastic paint or a proprietary plastic coating.

The netting is normally plastic (polyester) coated chainlink netting, green or black in colour. The most common specification is 50mm mesh, 3.55/2.5 gauge plastic coated with a galvanised wire core.

In heavy-duty applications it may be appropriate to employ heavier steel posts and netting. This may also be necessary on very exposed sites. Where there may be exposure to salt air or other severe atmospheric pollution it is recommended that the steelwork be galvanised as well as the wire core of the chain link netting.

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The greatest care should be taken if site screening materials are to be hung on the surround fencing, to ensure that the surround fencing is sufficiently robust. The constructor's advice should always be sought. A heavy-duty surround will be required for this purpose.

Chain link netting should be in single width to a height of at least 2.75m. Thereafter a neatly made joint is permissible where higher surrounds are specified.

Surround fences are normally 2.75m in height, but this may be increased to 3.6m or more if balls hit out of the court are likely to constitute a danger to traffic or passers-by, or if they would be difficult to retrieve. Additional gates in the surround fence will also facilitate the retrieval of balls.

Other types of netting are sometimes used for tennis court surrounds, but it is important to remember that tennis balls must be stopped by the netting and should not rebound back into the area of play.

3 Section Three – Maintenance

3.1 General Court Care Common to All Surfaces

3.1.1 Footwear

Good quality tennis shoes are recommended for all surfaces. Training shoes or other types of footwear with bars, studs or sharp serrations on the soles should not be used.

Players will find it advantageous to have two or three pairs of shoes with different sole types. For instance, a smooth sole that may give perfect grip on a dry surface may need to be replaced with a sole with more grip when the same surface is damp or wet. Similarly some sole types may give too firm a foothold on some surfaces which may over-stress knees and ankles etc. Trial and error will soon indicate the optimum sole for any given type and condition of surface.

It is useful to have a notice at the entrance to the court recommending the correct type of footwear. A player wearing incorrect shoes with aggressive soles can do a great deal of damage in a very short time.

It is also wise to avoid black soles on painted surfaces because these tend to leave unsightly black marks, which are difficult to remove.

It is advisable to have some form of mat, scraper or shoe-cleaning device at the entrance to the court so that players can clean their shoes before going on the court.

3.1.2 Furniture, Toys and Equipment on the Court

Most surfaces will be indented and therefore damaged by heavy or sharp objects standing on the court.

Umpire's chairs, garden seats etc. should not be put directly onto the surface, but boards or pads should be placed under the legs to spread the load.

It is also essential to prohibit roller-skates, skateboards, bicycles, wheelbarrows full of sand and anything else that children may bring on the court and which could do damage to the surface. Family pets should also be excluded.

Machinery being used on the court surface, such as compressors, water-pumps etc. should be stood at all times on a piece of plywood or similar.

3.1.3 The Court Perimeter

A strip of ground at least two feet wide outside the surround fence should be kept clear of vegetation at all times to form a barrier against plant and weed encroachment onto the playing surface. This may be done quite simply with an appropriate weed-killer. It follows from this that climbing plants such as roses or clematis should not be planted to grow up the surround fencing. Not only may their roots disturb the court surface and their leaves pollute it, but they may cause severe damage to the fencing during high winds.

Shrubs, trees and hedges should be planted as far back from the court as possible, certainly allowing sufficient room between the surround fence and plants for maintenance to be carried out between them.

3.1.4 Tree Roots

Trees, hedges and shrubs to be planted close to the court should be chosen carefully to avoid any with aggressive root systems, such as poplars and sycamores, as these can cause major disturbance of the surface. If their use is essential, the insertion of a root barrier between the trees and the court is strongly recommended, just as it is when the court has to be sited near mature specimens.

3.1.5 Overhanging Branches

Branches of trees which overhang the court invariably cause problems. Water dripping from the branches may cause slippery or discoloured patches, encourage the growth of algae or moss and sometimes even erode the surface. The secretions of aphids coat the court surface with a sticky blackish substance, which may impair foothold and encourage algae and, in severe cases, damage the surface paint. Last, but by no means least, the droppings of larger birds, such as pigeons and collared doves, can cause damage especially to painted macadam surfaced during the summer months. For all these reasons overhanging branches should be pruned well back.

3.1.6 Substances to Keep Away From Tennis Courts

Cigarettes

All tennis courts should be made a “No Smoking” area. Cigarettes are unlikely to constitute a fire hazard, but cigarette ends will leave unsightly burn marks on most surfaces.

Chewing-gum

This should always be banned from tennis courts. Chewing gum is invariably difficult to remove, although some advice the use of ice cubes which harden the gum and allow it to be broken away more easily.

Petrol, Oil and Solvents

Petrol, oil or solvent spillages will seriously damage most surfaces, especially those that are bitumen-bound or are superimposed upon a bitumen-bound sub-base. Great care should be taken to ensure that any machinery used within the court area, such as a garden vacuum cleaner, is clean and in good repair and does not drip petrol or oil. It is strongly recommended that machines be removed from the court surface before refilling with petrol, diesel or oil. In the event of a spillage immediate copious irrigation with tepid water and detergent may minimise the damage.

Salt and De-icing Agents

As a general rule salt or other de-icing agents should never be used to remove snow or ice from tennis courts; their effect is unpredictable and they may cause serious damage.

3.1.7 The Net and Net Posts

Do not over-tighten the tennis net. This will cause damage or even breakage of the steel cable and in severe cases may pull the net posts inwards, occasioning a very costly repair.

A common cause of the net being over-tightened is that the centre band is too short preventing the correct net height from being achieved. The centre band will usually be provided with a screw adjuster and this should be slackened to allow the net to be adjusted correctly, and then carefully re-tightened.

The correct height for the net is 3' 0" (0.914m). The traditional method of using two rackets to provide the correct measurement is no longer practical, because of the diversity of modern rackets. A net measuring stick should be available at all times for this purpose.

The net should always be slackened after use to reduce strain on the equipment and to prevent lower temperatures at night causing the cable to contract and be stressed still further.

It is also a wise precaution to wrap the net over its headband to prevent the net being abraded by the surface as it blows in the wind.

If the court is not to be used during the winter, both the net and the net posts should be removed and stored, ensuring that they are first carefully dried.

The winding mechanism should be greased occasionally to ensure smooth and quiet operation and the posts checked for rust. It can also be helpful to lightly grease the post sockets and that part of the posts that fits into the sockets. This can greatly facilitate the removal of the posts, especially if they are left in position for long periods.

3.1.8 Weeds

Before constructing the court, the installer will have applied a good, general weed killer to the site, following the manufacturer's recommended coverage rates. This is usually effective but sometimes some weed growth may occur, either involving highly resistant species or windblown seed. It should not be automatically assumed that the weed-killing process has, therefore, been carried out inefficiently. It is simply that, in spite of all the wonders of modern science, there is no safe herbicide in existence that can be guaranteed to kill all weeds on tennis court sites prior to construction and to ensure that no subsequent growth will take place. Such weed growth that does occur usually represents a temporary inconvenience and only very rarely constitutes a significant threat to the court.

The extent to which weeds may constitute a nuisance will also depend very much on the type of surface and the location of the court. Weeds are virtually unheard of on porous concrete surfaces and are rare on impervious acrylic surfaces. Windblown seedlings can sometimes establish themselves in sand-filled artificial grass surfaces, but usually wither away quickly.

It is on bitumen-based surfaces, such as grey-green or porous macadam, where troublesome weeds are most likely to be encountered.

Whilst weeds are unlikely to constitute a major problem, they will appear in a small number of cases, more especially in the year following the construction of the court. The secret is to deal with them promptly and not to allow them to become established.

Courts sited in fields, paddocks or other weedy areas or adjacent to suckering trees, may be at increased risk beyond the immediate post-construction period. This is because of tree roots giving rise to suckers and certain weeds, such as creeping thistle, can spread rapidly underground and may re-infest the tennis court site thereby. In these circumstances, it is advisable to maintain a weed-free "cordon sanitaire" around the perimeter of the court by applying a good, general weed killer regularly to a strip of a minimum width of 1m (3 ft) immediately outside the court surround fencing. This will check underground growth before it reaches the court.

Treating Weeds

All grass, weeds, seedlings and shallow rooted plants should be treated with a suitable weed killer.

Deep-rooted weeds, such as thistles, convulvulus, bindweed, mare's tail, tree suckers, etc. should be treated with a systemic weed killer, spraying all the growing parts of the weed thoroughly with the solution. These weed killers work by being carried down to the roots of the plant and, therefore, act more slowly. The weeds should be left in situ until the weed killer has taken effect. Systemic weed killers will only work very effectively on young, fast-growing weeds and will be less effective late in the summer when the weeds have hardened off and growth has slowed down.

General Hints

Treat weeds as soon as they appear – do not let them become established.

When the weeds are dead they may be carefully removed. Great care should be taken not to disturb the surface of the court. A sharp, narrow-bladed knife may be useful for cutting off thick weed stems below the surface. If the weed has lifted the court surface, it should be carefully trodden down with the flat of the foot once the weed has died.

If very deep-rooted weeds persist in spite of the spot treatment described above, advice should be sought from either the installer or a specialist weed-killing company.

3.2 Maintenance of Porous Macadam Courts

3.2.1 Introduction

Porous macadam tennis courts consist of a permeable foundation of broken, graded stone, on which is laid the macadam base-course and wearing course (or playing surface). This is then coated with a coloured, acrylic surface coating. The play-lines are then painted onto the coloured surface, but self-adhesive tapes may also be used.

The resulting tennis surface is fully permeable, hard-wearing, and playable throughout the year and requires relatively little maintenance. But however modest this maintenance requirement, it is, nevertheless, of vital importance if the surface is to remain good to look at, good to play on and long-lasting. Indeed, the installer's guarantee is likely to be conditional upon the recommended maintenance requirements being carried out with reasonable efficiency.

3.2.2 What Maintenance and Why

The maintenance procedures are designed to ensure that:

- The playing surface is kept scrupulously clean;
- The free drainage of surface water is maintained throughout the life of the court; and that
- The court looks attractive and well cared for at all times, and achieves a reasonable life span.

These objectives are achieved by:

- Sweeping or vacuuming leaves and other detritus from the surface;
- Occasionally washing the surface; and
- Applying prophylactic treatments of moss-killer.

3.2.3 Keeping the Surface Clean

Leaves, tree flowers, pine needles, fluff from tennis balls and other detritus should not be allowed to remain on the surface for any length of time. If this happens they rapidly rot down and settle into the interstices of the surface impairing drainage and providing a growing medium for algae and moss.

A wide soft broom can be used to sweep the surface but this has a tendency to push smaller material into the surface. A rubber-tined rake is usually better, albeit rather slow and arduous. Best of all is a mechanical garden vacuum cleaner, which will greatly speed up the operation and do it more efficiently. Mechanical leaf sweepers can also be good. The equipment should be well maintained and carefully operated to avoid contamination of, or physical damage to, the playing surface.

At least once a year the court surface will benefit from a vigorous wash. This not only has the effect of keeping the surface interstices clean and free-draining, but is also essential for maintaining good foothold. Courts near busy roads are particularly susceptible to becoming coated with “traffic film”, whilst those near trees may become coated with “honey-dew” from aphids. The resulting black film from either cause can make the courts very slippery after rain.

If the water pressure is reasonably high, washing can be carried out with a domestic hosepipe assisted by a mild cold water detergent. Even more effective are the cold water pressure washers that are available from most equipment hire outlets. These must be used with care, however, the greatest attention being paid to establishing that the process is not dislodging the coloured surface coating or stone chippings. Again mild, non-foaming detergent increases the efficiency of the operation. Steam cleaners should not be used. If the court surface has become very badly sealed and does not respond satisfactorily to this treatment, consult the installer or a firm that specialises in cleaning tennis courts.

3.2.4 The Post Construction Period

The installer will have indicated when play can commence on the new surface, and his instructions should be followed meticulously. In particular unsuitable footwear and other bad habits such as “racket abuse” should be prohibited, especially in warm weather.

On a very new court water will sometimes stand on the surface after heavy rain. This is a very temporary phenomenon resulting from surface tension, and should not cause concern unless it persists.

3.2.5 Play In Hot Weather

The modern porous macadam tennis surface can be produced with special additives to lift the temperature at which it softens in hot weather, significantly above that which renders normal macadam surfaces unusable. The surface coating is also beneficial in this respect. Nevertheless, a court may still soften in hot weather, especially in the first season after construction. Thereafter the tendency to soften should diminish rapidly.

If the surface softens play should be stopped immediately, because serious damage can result from continuing to play. The first sign of the problem is usually when black marks begin to appear as a result of the paint being rubbed or scuffed off. It is sometimes possible to cool a hot surface by hosing it down with cold water to allow evening play to take place.

Softening is a phenomenon usually confined to the first season, but, even thereafter for a year or two, the surface should be checked if very hot weather is experienced.

3.2.6 Bird Damage

An unusual nuisance that may sometimes be experienced is damage caused by bird droppings. This is usually only a significant problem during the first year or two of the court's life, during the summer months, or where branches overhang the court.

The droppings adhere to the surface, dry out in warm weather and shrink. In the process the paint coating and even stone chippings may be pulled off.

The remedy is to cut back overhanging branches. If the droppings are already in-situ they should be hosed away. Damaged spots should be carefully firmed with the foot and touched up with surfacing paint.

3.2.7 Worms

Another rare cause of surface damage is that caused by worms. In mild, wet weather worms sometimes appear on the court surface, usually in ones or twos but very occasionally in larger numbers. How they get there is something of a mystery, but once on the surface they seem unable to get any further and usually die. In warm weather, they then adhere to the surface and shrink causing very similar damage to bird droppings.

Worms on the playing surface should be removed as soon as possible. Damaged spots should be carefully firmed with the foot and touched up with surfacing paint.

If the problem persists consideration should be given to applying an appropriate worm-killer. Repeat applications may have to be made, copiously watered in, to ensure that the subsoil beneath the courts is impregnated.

3.2.8 Snow and Ice

Snow and ice should not prove harmful and can be allowed to melt through in due course. Powdery snow can be swept away using a wide soft broom or wooden scraper. Metal shovels

or scrapers should not be used because they may damage the surface, as will mechanical snow removing equipment, such as mini tractors.

Do not use salt, urea or other chemical de-icing agents. Their effect is unpredictable and they can cause severe damage.

3.2.9 Maintenance Schedule

Daily - at the end of the days play.

- Make sure the net is slackened and rolled up in the middle
- Make sure the gate is shut.

Weekly

- Clear leaves and rubbish from the court.

Monthly

- Deal with any moss or algae.

Annually

- Wash the court.
- Apply moss-killer
- Call in the installer if any aspect is causing significant concern.

Note:

These are minimum recommendations. Common sense and careful observation should prevail. If any serious doubt exists about the effectiveness of the maintenance regime or the condition of the court, the installer should be contacted. It is better to be safe than sorry.

3.3 Maintenance of Sand-Filled Artificial Grass Tennis Courts

3.3.1 Introduction

Most sand-filled artificial grass tennis courts consist of a permeable sub-base, usually of macadam, upon which is laid a tufted, polypropylene fibred carpet. The fibres vary in length and density. The carpet, which is loose laid, not adhered to the sub-base, is then dressed with graded silica sand, which fills the interstices between the fibres. The weight of the sand is sufficient to keep the carpet firmly in place. Play-lines are either tufted into the carpet and are therefore integral with it, or are subsequently cut in using similar carpet materials of the appropriate white or yellow colour. Occasionally play-lines are painted onto the surface, but these are decidedly temporary and need frequent re-painting.

The resulting tennis surface is fully permeable, hard-wearing and requires only a modest amount of maintenance. This maintenance is, nevertheless, of vital importance if the surface is to remain good to look at, consistent in play, permeable and long lasting. Indeed, the installer's guarantee will usually be conditional on the recommended maintenance requirements being carried out with reasonable diligence.

3.3.2 What Maintenance and Why

Maintenance procedures are designed to ensure that:

- The playing surface is kept scrupulously clean;
- The play surface is level and of consistent texture to give a true and predictable game;
- The free drainage of surface water is maintained throughout the life of the court; and that
- The tennis court should look attractive and well-kept at all times.

These objectives are achieved by:

- Sweeping leaves and other detritus from the surface;
- Brooming the surface to freshen the fibre surface, counteracting any slight sand drift or compaction and counteracting any tendency to form an impervious skin on the sand surface that might impair drainage; and
- Applying prophylactic treatments of moss-killer and/or algaecide.

3.3.3 Keeping the Surface Clean

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

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

Brooming

Brooming the surface is a crucial operation if premature loss of appearance and drainage is to be prevented. Apart from freshening the look of the surface (rather like a lawn mower striping a lawn), the purpose of regular and fairly vigorous brooming is to prevent the formation of a compacted and impervious skin on the top of the sand layer, which will inhibit drainage and encourage moss and algae.

A three-foot wide broom with bristles of medium stiffness is best; the installer should be able to recommend or supply the correct type. It can be dragged over the surface or, better still, pushed. Brooming should ideally be done in both directions: in the length of the court and then at right angles across it, but if this is too time-consuming, the direction of brooming can be varied from time to time.

The recommended frequency of brooming must depend on the amount of use the court receives and whether its location is open and “clean”. Once a week is recommended, but it may be advisable to broom more often if the court is heavily used, shaded or subject to pollution.

There is a selection of mechanical brooming machines available, which will speed up and lighten the operation and these are recommended at clubs and other venues where there are several sand-filled artificial grass courts. The machines vary in the vigour with which they broom the surface: some are rather fierce and are only recommended for use by experienced operatives and where heavy remedial brushing is needed. Combined brush and vacuum machines must be used with even greater care because sand brushed and sucked from the surface may be very difficult to replace, especially when the court is well worn.

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

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

If, in spite of the regular brushing described above, or as a result of a lack of it, the sand-filled surface becomes over-compacted and impervious, this condition can often be corrected by appropriate treatment usually involving the use of specialist machinery. Machines vary from simple scarifiers to more elaborate proprietary machines that remove a proportion of the sand from the carpet, which is then replaced with new sand. The best of these processes will prolong the useful life of the carpet by a number of years.

3.3.4 Moss and Algae

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

As soon as signs of moss are found it should be treated immediately, the application being repeated until the moss can be brushed and cleared away. In the case of very severe infestation, the installer should be consulted. High pressure cleaning equipment is now available but its use is a skilled process.

It should be emphasised that moss is only a serious problem if it is allowed to become established. Regular brooming and use of the court renders moss an even less likely problem.

3.3.5 The First Month or Two

Immediately after construction there is an initial working-in period during which the final playing surface is created.

Initially the court surface may be left rather sandy, but full penetration of the sand infill into the carpet pile and its subsequent stabilisation into a uniform playing surface occurs naturally, especially as a result of rainfall and initial play. This process usually takes two to three months.

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

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

3.3.6 Play-Lines

An artificial grass court will normally be supplied with permanently in-laid playing lines. However, if additional lines are required for special events, these can be painted onto the surface using water-based paints. Chalk lines can be applied but these tend to leave a lasting powder spread in the area of the line.

Permanent lines require no special attention.

3.3.7 Stain Removal

Most stains can be removed easily with a solution of hot (not boiling) water and a household detergent, such as washing up liquid. The removal of chewing gum can be simplified by using ice cubes to harden the gum. Heavy oil marks can be removed with a cloth and mentholated spirits.

3.3.8 Weeds

No matter how much care is taken, weeds may occasionally appear on the surface, usually as a result of wind-blown seeds. Small numbers of weeds can be removed by hand without damaging the surface.

Localised areas of weed seedling infestation can be treated with domestic weed killers without causing damage to the surface of your court. Oil based weed killers should not be used.

3.3.9 Snow and Ice

Snow and ice are not harmful and can be permitted to melt through. If it is important to remove the snow to enable play to start sooner than would otherwise be the case, brushes or wooden scrapers may be used. Metal shovels or scrapers may damage the surface and should not be permitted. Rock salt and chemical de-icing agents should not be used.

Provided that the foothold is adequate the court may be played on when frozen, but heavy use is to be discouraged because the fibre is relatively brittle at low temperatures.

If heavy rain falls immediately after a very cold spell, the court may become flooded for a few hours. This is because the sand beneath is still frozen, but should not be a cause for concern, as the ice will soon melt and the surface will then drain normally.

3.3.10 Footwear and General Court Care

Suitable footwear should always be used, i.e. good quality tennis shoes. If the court is used occasionally for other sports, a multi-studded boot with a stud length of 1/4" will be satisfactory. **Metal studs must not be used.**

It is strongly recommended that the court should be treated as a "no smoking" area as a dropped cigarette can melt the fibres down to the surface leaving an unsightly mark. Chewing gum should also be banned.

3.3.11 Maintenance Schedule

Daily - at end of the days play.

- Make sure the net is slackened and rolled up in the middle.
- Make sure the gate is shut.

Weekly

- Clear leaves and rubbish from the court.
- Deal with any new weeds, moss or algae.
- Broom court to redistribute sand.
- Check sand levels.
- Check for moss and algae growth, food stains, shoe marks etc. and remedy as appropriate.

Periodically - at least every six months.

- Apply grease to the net winding gear.

Annually

- Treat court with moss-killer / algacide.
- Call in the installer if any aspect is causing significant concern.

Note:

These are minimum recommendations. Cleaning, brooming and court inspection can always be done more frequently. Common sense and careful observation should prevail. If any serious doubt exists about the effectiveness of the maintenance regime or the condition of the court, the installer should be contacted. It is better to be safe than sorry.

3.4 Maintenance of Acrylic Courts

3.4.1 Introduction

Impervious acrylic tennis courts consist of an impermeable foundation of crushed, graded stone topped with one or two courses of dense asphalt. Concrete is sometimes used instead of asphalt.

This foundation is then coated with a number of applications of coloured, acrylic surfacing compound, the details of the process depending upon the system used. To improve comfort “cushioned” layers may be interposed between the foundation and the acrylic surfacing layers. Play-lines are painted on the surface.

The entire court is laid to a gradient, usually a cross-fall, to assist rainwater run-off.

The resulting court provides excellent playing conditions; indeed approximately half of all top level tennis tournaments worldwide are played on this type of surface. The courts require very little maintenance, are hard-wearing and are relatively easy and inexpensive to resurface.

It is important to remember, however, that the surface is completely impervious and that rainwater may take some time, especially in the UK climate, to run off and evaporate. If play is required to take place before the surface has dried naturally, special squeegees have to be used to remove excess surface water.

3.4.2 What maintenance and why

The maintenance procedures are designed to ensure that:

- The playing surface is kept scrupulously clean, to preserve its playing characteristics; and
- The court looks attractive and well cared for at all times, and achieves a reasonable life-span.

These objectives are achieved by:

- sweeping or vacuuming the surface to remove leaves and other detritus; and
- washing the court surface regularly to keep it clean

3.4.3 Keeping the Surface Clean

Leaves, pine needles, dust, dirt rubbish and all other detritus should be removed from the surface regularly using a wide broom, (medium to soft bristles, not too stiff or hard) or, better still, a garden vacuum cleaner. If the latter is used, it should be well maintained and carefully operated to avoid contamination or physical damage to the surface.

At least twice a year, (and more often if the courts are heavily used or are in a location subject to pollution by traffic fumes, aphid secretions etc.), the surface should be thoroughly washed using cold water from a hose pipe and a soft-bristled broom. Stains can be removed with mild detergent.

Surface moulds and algae may be a problem in shaded areas, especially during damp periods. They can usually be removed very effectively by washing with diluted domestic bleach. The bleach should be diluted to at least three parts of water to one part of bleach. The solution can be left on the surface for up to half an hour, but should then be thoroughly washed away with copious quantities of cold water.

3.4.4 Monitoring the Surface

Keeping the surface clean is the only routine maintenance that the court surface should require. In the unlikely event of other apparent defects arising, such as cracks or crazing, the installer should be consulted.

The surface should also be maintained to enable surface re-coating to be scheduled when required. A newly-laid surface should give firm foothold and good medium-paced game. As the surface is used over the years, however, it will become smoother and more polished. This may result in a somewhat faster game and, eventually, some impairment of the foothold when the surface is damp. When this happens it will be time for the surface to be re-coated. How often this will be needed varies considerably depending upon the system used, the intensity of use and the requirements of the players. The likely re-coating requirement should be discussed with the installer when the new court is handed over, and the condition of the surface maintained in accordance with the recommendations.

Maintenance schedule

Daily - at the end of the days play.

- Make sure the net is slackened and rolled up in the middle.
- Make sure the gate is shut.

Weekly

- Remove dust, leaves, rubbish and other detritus from the surface.

Monthly (or thereabouts depending upon the cleanness of the surface).

- Wash the surface, removing stains with a mild detergent and soft brush.

Annually

- Check the court surface carefully. Call in the installer if there is any cause for concern or it is suspected that the surface needs re-coating.

Note:

These are minimum recommendations. Common sense and careful observation should prevail. If any serious doubt exists about the effectiveness of the maintenance regime or the condition of the court, the installer should be contacted. It is better to be safe than sorry.

3.5 Maintenance of Shale and Clay Courts

3.5.1 Introduction

Unlike all other types of tennis surface in common use today except natural grass, shale and clay courts are only made fit for use by the regular implementation of detailed maintenance procedures. Given regular and expert maintenance these surfaces can provide playing conditions of the very highest quality; indeed clay courts are still used for many major international tournaments throughout the world. In the absence of this regular and expert maintenance, however, the court surface can deteriorate rapidly and may become unusable. The installation of these types of court should only be contemplated, therefore, if adequate resources can be made available to maintain them, and unless there is a strong commitment to apply those resources on a permanent basis. However, it also has to be said that some types of clay court require less maintenance than others.

“Continental clay” from mainland Europe and the “fast-dry” surfaces from North America require less maintenance and are easier to keep in first class condition than indigenous UK clay courts. The difference is that the typical UK court can be kept in play in non-frosty weather throughout the winter whereas the overseas versions cannot.

There is one final point that needs to be emphasised by way of introduction. There is a limit to which the maintenance of these courts, especially the indigenous UK version, can be reduced to a set of instructions which, if followed by maintenance staff, can produce the optimum result. There is a point at which the instincts and experience of a successful grounds man must be allowed to take over and for which there is no written substitute if the best results are to be consistently achieved.

3.5.2 Some General Principles

All surfaces in the clay or shale category work on the same basic principle. A graded surfacing material, which may be clay (e.g. crushed brick or roofing tiles etc.), shale (e.g. crushed burnt pit shale or Scottish “blaes”), or fine crushed rock from various sources is transformed into a smooth and firm playing surface as a result of watering and rolling. In fact, most successful products are a blend of two or more of these materials. In particular, very fine shale or gypsum is frequently added to improve the cohesive qualities of the surface, or “bind”.

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The bind or cohesiveness which is so essential if the surface is to remain stable during play, results from the hygroscopic action of the water, the inherent cohesiveness of the clay, limestone or additives, and mechanical compaction resulting from the grading of the material and rolling. Usually all three sources of bind are needed to produce a successful playing surface. Thus a surface that has dried out will be brittle and will break up quickly, the mechanical bind alone being insufficient to hold it together. Similarly a poorly graded material will be difficult, if not impossible, to prepare for play because the mechanical binding properties are not present.

Finally, to complicate further the design and maintenance of these surfaces, the court must recover reasonably quickly from any rainfall that may be expected during the intended playing season, and must therefore be sufficiently permeable and without any undue tendency to become sticky underfoot.

It follows from the above that the maintenance regimes that are recommended for the various surfaces in this general category, all centre around first wetting the surface, and then rolling it. It further follows that the surface must remain sufficiently damp while in use to prevent it breaking up and becoming loose or pitted. Thus the availability of an adequate water supply and an efficient means of applying it to the court is no less essential than the availability of adequate, properly equipped and trained ground staff.

The basic principles of maintenance can be slightly elaborated by saying that it is normally desirable, if not essential, to repair any damage or disturbance of the surface before watering it. Following watering it is also usually desirable to broom or drag the surface before rolling to counteract any disturbance or stickiness caused by the watering. The basic maintenance format can therefore be restated as:

- Repair – Water – Brush – Roll

It is not always necessary to follow this routine strictly, provided the basic principle is understood. The various materials differ in the degree to which it is possible to omit one or more of the four basic operations, (although watering and rolling are always essential), and sometimes it becomes desirable to deviate from the basic routine to produce a given result. For example, brushing, dragging or brooming a dry surface is usually highly undesirable because it will break up the surface cohesion and leave the surface very gritty. Sometimes, however, this is a desirable result if, for instance, the surface has become over-consolidated. There are other exceptions to the general rule of “repair, water, brush, roll which will be mentioned later.

3.5.3 Tools and Equipment

The basic equipment needed is:

- Motorised roller and/or hand roller
- Broom - semi stiff 3ft wide
- Broom - soft 3ft wide
- Drag Mat
- Line brush
- Loot (wooden scraper)
- Rubber rake
- Hose pipe and sprinkler rose
- Standard general purpose tools, e.g. wheelbarrow, garden fork, shovel, buckets, string line etc.

These days' people expect rollers to be motorised and this does, indeed, take most of the hard work out of the operation of rolling, and greatly speeds it up. A motorised roller is a must for a multi-court installation. However, it should not be forgotten that a clay court can be kept in excellent condition with a good quality hand roller, and if funds allow a hand roller should be provided in addition to the motorised roller. It will be very useful for localised repairs, and a valuable stand-by in the event of mechanical failure.

The installer's advice should be sought about the choice of motorised roller. The pedestrian or tandem rollers commonly used in footpath construction, and which are freely available from plant hire companies, are not really suitable for use on clay courts. They are too heavy, often have rollers too small in diameter and in other respects are far from ideal. In particular, the roller is not required to vibrate, and it is better not to tempt providence by using a roller that will vibrate if required, as it could do untold damage. More suitable sports surface rollers are available, and the installer will be able to give advice.

Whatever type is selected, the motorised roller requires careful maintenance and above all must not have a "snatchy" brake or reversing mechanism. Sudden or jerky stopping and starting can cause considerable damage to the surface. Suitable rollers will vary somewhat in weight but as a general rule should be around 1/4 tonne (4-5 cwt) per roller (i.e., 1/4 tonne if of the pedestrian type, or 1/2 tonne if a two roller ride-on type). The hand roller should also weigh around 1/4 tonne. It should be of "double-cylinder" construction and have rounded not sharp edges. The twin cylinders act like the differentials on a car and make the roller much easier to turn and less likely to shear the surface.

When the court is damp, the surface material may adhere to the roller. It should be provided, therefore, with an efficient scraper to keep the roller surface clean. A good scraper can be improvised by wrapping hessian around a piece of wood, or by fixing a wide, semi-stiff broom so that it continuously cleans the roller.

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The brooms or brushes should not be less than three feet in width. They should be dragged and not pushed. The semi-stiff broom, which works as a "scarifier", can be wider still although five feet is about the widest that can be managed. The soft broom, which is for final preparation work, is plenty wide enough at three feet.

Once again, brooms should be in good condition and kept clean. Brooms with badly worn bristles can be used as roller scrapers!

The so-called "whale-bone" drag brushes are too fierce for most tennis court maintenance and should only be used with great caution. A narrow line-brush will be required to clean the line marking tapes. Excellent mechanical line-brushes are available.

The loot (wooden scraper or toothless rake) is an essential piece of equipment, which must be kept in good condition. With hard use the blade will wear, cease to be straight, and develop round edges. When this happens it should be planed straight or replaced.

Rubber rake - is ideal for removing leaves and other debris without disturbing the surface.

A drag-mat is usually a homemade article consisting of old hessian bags, door mats, carpet or even an old coir gym-mat. It is dragged over the surface to level off disturbed surface material. Flexible metal drag-mats are also available and can be very good, if a little "fierce".

Hose pipe and sprinkler rose - all too often these days water supplies are totally insufficient for watering hard courts. The bigger the bore of hose that can be used the better. 3/4" is a minimum, with 1" better still. The rose should not be too fine or the flow of water will be seriously restricted. A hosepipe is an essential item even if a permanent sprinkler system is installed. If a permanent system is not available and mobile sprinklers are used, the model chosen should be simple, robust and should not restrict the flow of water too much. Small, fine mist sprays are not very helpful and in hot weather completely ineffective.

Permanent irrigation systems come in various forms. They are all designed to soak the whole of the court area at the turn of a valve by means of spray lines or pop-up jets down the sides of the courts. The sprinkler lines or heads should be inspected regularly to ensure that a proper spray pattern is maintained. A partially blocked spray jet dribbling onto the court can dig a surprisingly large hole in a very short time.

3.5.4 The Basic Maintenance Operations

The basic maintenance operations such as repairing, brushing, watering and rolling are generally common to all types of surface, varying only in detail from one to another.

Repair

The maintenance sequence normally starts after the courts have been used and need to be restored before further use.

After use the court surface will have been disturbed to a greater or lesser extent and the first operation, before anything else is done, is to replace displaced material. Individual areas can be dealt with using the loot, pushing and pulling the loose material back into place and tamping it lightly with the flat edge of the loot blade if the damage is fairly deep.

If the damage is minor the loot may not be needed at all, going over the whole court once or twice with a drag broom, (usually the soft one), or a drag mat being all that is necessary.

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Whether or not the loot is needed, drag brushing or drag matting is the operation that precedes watering and rolling (or just rolling if the material is moist enough).

When dragging a mat or brush, the operation should be performed systematically and with precision. Lifting the brush or mat will leave a ridge of loose material behind, so it is better to operate continuously, turning without stopping at the ends or sides. The straight systematic patterns on the surface are the sign of a conscientious and methodical grounds man.

If there is foreign matter on the surface, such as leaves or excessive large grit, then some of this can be removed by lifting the brush away at the end of the court and looting off the ridge of grit and debris left behind. If there are a lot of leaves or foreign matter it is better to take them off first with a rubber rake.

Occasionally, deeper holes may need repairing, usually at the baseline. Looting material into these may not be successful because this material will tend to be gritty and loose and soon comes out again. If this is the case, the hole should be made up with a little new surfacing material, tamping lightly before watering. If the base of the depression is smooth it is important to scarify it lightly with a fork to give a key for the new material.

Repair of larger depressions or areas of damage is dealt with elsewhere.

The most important thing of all is to perform this repair operation as soon as possible after play has ceased. If rain falls on the court after play but before the repair operation, it will be much more difficult to carry out and some of the benefit of the free watering will be lost. The sensible grounds man will always try to avoid leaving a court unrepaired for a moment longer than is necessary.

Remember:

- Repair before watering or rolling.
- Repair as soon as possible after play ceases.

Watering

There is nothing better than rain for watering a tennis court. Unfortunately there is a tendency for Mother Nature to overdo (or under do) the quantity of water and her timing is not always perfect. Nevertheless, the grounds man will keep his weather-eye open and make the most of the UK climate. It can save him a great deal of work (and water bills).

Failing rain, the water must be applied artificially by:

- Hand watering with a hose pipe;
- Portable sprinkler; or
- Permanent irrigation equipment.

Hand Watering

This is a good method only if the water supply is copious and the pressure reasonably high. But with a 1 inch hose and a coarse spray the job can be done remarkably quickly. The disadvantage is obviously that the operation is labour intensive, but there are also advantages.

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The water can be put exactly where it is needed, in exactly the right quantity. No automatic sprinkler has ever been invented that does this.

The water should be directed slightly upwards to allow the water to fall on the surface rather than being aimed straight at it with the danger of washing it away.

Always apply plenty of water, sufficient to soak right through the surface. Half way through is not good enough, and can cause serious problems.

Be careful when pulling a hosepipe over the playing surface, especially if it is a heavy rubber one, as it can cause damage.

Portable Sprinklers

There are a large number of mechanical sprinklers available on the market. Many are good, being reliable, effective, and robust. However, some are lightweight and gimmicky, being designed for small gardens, low water pressures and ½ inch hosepipe.

The latter should be avoided in preference for simple, robust designs that put down as much water as possible in a short time. Sprinklers that give mist sprays over large areas should be avoided: they are often of little use, especially in windy or hot dry weather, much of the water blowing off the court area, or evaporating before it can soak in.

The sprinkler should be positioned so as to cover as much of the court as possible, taking into account the direction of the wind. It is rarely possible to soak the whole area of a court this way, but areas missed can be quickly watered by hand.

Remember:

- Thoroughly soak the surface right through.
- Rain is the best watering system of all. Be prepared to take advantage of it.

Brushing

After watering and before rolling, the surface should normally be brushed lightly with the soft broom.

The watering process will leave an uneven and often unsightly pattern of whorls on the surface. Brushing will obliterate these, before rolling completes the maintenance process.

Where water has stood before draining away, the surface may be sticky because the very fine clay suspended in the water has been filtered out by the surface. The process of brushing will break the skin of stickiness and bring a small amount of fine grit to the surface to give a better surface for rolling.

The timing of the operation is important. It should not be carried out too early, when the surface is still wet and too sticky, nor too late, when the drying surface will become too gritty to roll down properly.

At this stage the brushing, by dragging the broom should be neatly and carefully carried out, turning and not lifting the broom at the ends. The brush lines should be kept straight and of even width. They will help to produce a good-looking surface as well as a good one to play on.

Remember:

- Time the brushing correctly: not too early, not too late.

Rolling

Rolling is ostensibly a very simple operation, but one where the basic principles are more than usually important.

When rolling a steady and even pace should be maintained, rolling methodically so that the entire surface receives the same amount of rolling at the same time.

The roller should not be stopped, started or twisted suddenly: all movement should be slow and controlled. When arriving at the end or the side of the court the movement over on to the next pass should be made slowly so there can be no chance of the twisting action of the roller shearing the surface. This is why a double cylinder roller with rounded edges makes the operation easier and less likely to cause damage.

These recommendations are all the more important when a motorised roller is used.

A vibrating roller should never be used. If the only roller available is of the type that can be made to vibrate, it is a good idea to ask a mechanic to render it impossible to engage the vibrator.

“Shearing” is one of the most difficult problems encountered in clay court maintenance. It is caused by a “shear line” developing between the surface layer and the foundation, or within the surface layer itself. Whatever the cause, and wherever the shear-line, the result is the same. The uppermost part of the surface becomes more or less permanently detached and will not re-attach itself automatically. The visual indication of shearing is close horizontal parallel wavy cracks in the surface, which are usually noticed after the roller has passed.

No amount of rolling will correct the situation. Sideways pressure with the foot will result in the unattached layer being pushed off altogether. A player running to recover a ball and stopping or turning on a sheared layer will lose all grip and displace deep divots.

The most frequent cause of shearing is careless rolling, such as over-sudden stopping and starting or changes of direction. Even more problematical is rolling the surface when, after frost, the surface has thawed but is still frozen lower down. A whole court can be sheared and ruined in a few minutes in this way.

When starting rolling it is important to make sure that the surface is not too wet. If it is, excessive amounts of dressing will cling to the roller, and it is then better to wait until the surface is drier.

A dry surface should only be rolled if it has become exceptionally powdery and loose and needs watering. If it is watered in a very dry, loose, unbound state, there is a danger of working the fine particles through. One pass of the roller will prevent this - a rare example of where the surface should be rolled before watering.

The surface should be rolled in nice, straight, consistent lines and patterns. The roller marks will remain behind when the court is returned to the players. Like the patterns left on a grass court by the mower they create a good impression.

The direction in which rolling is carried out should be varied, alternating between rolling lengthways and across the court. Consistent rolling in one direction results in the surface beginning to wave or undulate, a tendency more pronounced the smaller the diameter of the roller.

Rolling, like all other maintenance operations, will be much more difficult with the post and net in position. A good grounds man makes sure the net posts can be lifted out quickly and easily and that there is an efficient lid on the sockets.

The surface of the roller should be clean at all times. Even if a roller scraper or brush is attached, lumps of fine, sticky material sometimes build up on the surface of the roller drum. The bigger the lumps get, the more obvious the pattern they stamp into the court surface, and they should therefore be scraped off.

3.5.5 Finishing Touches

After rolling, only final tidying and preparation is required, before play can commence.

The play-lines must be swept clean of grit and dust, either by hand with a special, narrow brush or with one of the small brushing machines made for the purpose.

Any loose bits, pieces or lumps that have fallen from the roller should also be removed.

The net should be replaced, and a final check made that everything is complete, neat and tidy. The court should now be ready for play.

3.5.6 Moss Control

Normal routine maintenance should prevent weeds from becoming established on the surface, but moss can be a problem, especially in shaded perimeter areas or if the surface is heavily compacted. It should be treated with a proprietary moss-killer, and when brown and dead the moss should be carefully removed with a loot. A further, preventative application of moss-killer is then a good idea.

3.5.7 Salt in Winter

Traditional UK clay or shale surfaces are designed to be used during open weather in winter. They are, however, quickly put out of action by frost and this can happen even until late May. To reduce the effect of frost common salt may be used.

Rock salt cannot usually be obtained crushed sufficiently fine, so vacuum dried salt is to be preferred, which is easily obtained from chemical merchants. It should be applied evenly to a damp surface at a rate of approximately 100kg per court. Top up applications can be made as required. Too much salt, however, makes the surface sticky, and if this happens no more should be applied until the rain has washed through the excess salt. Salt is not easily stored so only sufficient should be purchased to meet immediate requirements.

3.5.8 Deliquescent in Summer

Salt, which may be used in frosty periods in winter, is also an effective deliquescent, i.e. it attracts and retains moisture in the surface, slowing down the rate at which the surface dries out and reducing the need for frequent watering.

Vacuum dried salt should be dressed evenly over a damp surface at a rate of 100kg per court per application. Once again, it should be remembered that too much salt will make the surface sticky.

An even more effective deliquescent is calcium chloride which is easily obtained from local chemical merchants. It is, however, even more difficult to store than salt. It should be applied just like vacuum dried salt, but not in excess because it too will make the surface sticky.

3.5.9 The Post-Construction Phase

Shale and clay courts require some time to settle down after construction and, depending on the type, may take anything from one to six months of restricted use before they cease to be "tender" and are ready for full and normal use.

Leaving the courts to lie "fallow" after construction serves no useful purpose, indeed quite the reverse. Full consolidation can only be achieved by a combination of carefully controlled use and regular maintenance.

In the very early stages a new court is best used by the less robust and athletic players - the more elderly gentlemen and ladies are the ideal candidates for breaking in the new surface. Vigorous men's singles should be kept for later on. The grounds man must be allowed to dictate the extent and scheduling of this early use, to enable him to water and roll before the new surface becomes unduly disturbed.

Having said this, the more the new court is used and the more regularly, therefore, it has to be maintained, the quicker it will settle down, and the restrictions can be lifted.

A full understanding of these post-construction limitations is important if disappointment and soured relations with the installer are to be avoided.

3.5.10 Scheduling Play

It is the nature of shale and clay courts that, unlike most other types of tennis court, they are not permanently in a suitable condition for play to take place. They may be rendered unfit by frost or heavy rain, or in a heavily worn state following lengthy periods of play, and before the maintenance operations described above have restored them to full readiness. To attempt to use them in these circumstances will, at best, result in a very poor game of tennis, but could also result in the playing surface being seriously damaged.

It follows from this that there must be close liaison between the club manager, players and the grounds man. The grounds man must be aware, sufficiently in advance, of the intended schedule of use, and he must be able to dictate changes in the schedules if he is unable to prepare the courts adequately and in time for whatever reason. The best shale and clay courts are only produced when all the involved parties work as a team, understanding and respecting each other's requirements and problems.

3.5.11 Detailed Maintenance Recommendations for Specific Surface Types

This section has dealt so far with general maintenance principles and procedures more or less common to all surfaces in this category. The following notes now provide more detailed recommendations for three main types of shale or clay courts.

- Fast-dry
- French clay
- English shale (or “En-tout-cas”)
- Other water-bound surfaces

3.5.11.1 Fast-Dry

This surface, that is marketed under several proprietary brands in the US and elsewhere, consists of finely-crushed, greyish-green naturally occurring rock, to which gypsum is usually added as a binding agent. The surface is pale grey when dry, but dark green when damp

Whilst only recently introduced into the UK, early experience suggests that these surfaces will be the least demanding in terms of maintenance in the whole category. This is not to imply that their maintenance can be neglected or that the general procedures set out above do not apply. Early indications are, however, that given efficient watering equipment fast-dry surfaces are robust and relatively undemanding.

General Maintenance

Brushing or Drag-Matting

The court should be brushed by pulling a broom or drag mat over the surface after play has finished. If the court is being heavily used for long periods, it may also be helpful to carry out this operation half-way through the day.

This regular brushing, brooming or drag-matting should be carried out in different directions, i.e. in the length of the courts and then across the courts more or less alternately.

Watering

Fast-dry courts play best when slightly damp and thus dark green in colour. When the surface becomes too dry it will change to light grey and it is time for it to be watered. The frequency of watering and the amount to be applied to maintain the "slightly damp and dark green" condition is a matter of observation and experience.

The best time to water the courts is at the end of the day when play has finished and the surface has been brushed or drag-matted.

Rolling

The court should be rolled after heavy or prolonged rain, and at least three times per month in addition.

Rolling should be carried out in alternate direction using a suitable 1/4 tonne roller. Rolling is most effective when the surface is damp.

In the immediate post construction phase the court should be rolled in alternate directions daily for not less than a week.

Patching

If small depressions appear, for example on the baseline, which do not respond to routine brooming or drag-matting, they must be patched.

The area of the depression should be cut out down to the foundation material with a brick layer's trowel or similar. The removed material must then be replaced with new surfacing material. The new material should be dry. It should be consolidated and struck off level with the surrounding areas with a loot or small straightedge. The patch should then be thoroughly soaked, and when only damp again lightly broomed and rolled. The patching process is then complete.

Top Dressing

Some surfacing material will be lost as a result of wind, rain and continuous play. This should be replaced by top-dressing the whole surface annually with a minimum of one tonne of new surfacing material. This is best done after the winter when preparing the courts for play again.

Crossfalls and Rainwater Run-Off

To assist in the dispersal of rainwater from a surface that is relatively slow-draining, fast-dry courts may be laid to a gradient. It is important to ensure that in these circumstances, rainwater flowing across the surface can run off the surface freely and not be held up by edging kerbs.

If this happens large puddles can develop which will not only delay the start of play but may also render the surface sticky and unsightly. Adequate gaps should be left in edging kerbs to allow the water to flow through freely to catchment drains or gullies. Care should be taken to ensure that the gaps in the kerbs or other means of getting rid of surface water are kept clean and operate efficiently.

Restoring the Surface after the winter

During the winter the surface will have lifted and become puffed up as a result of frost action. In this condition it retains a lot of water.

In the spring when the worst of the winter weather is past, and at a time when the court surface is relatively dry, it should be rolled carefully once in each direction.

The line tapes should then be removed and the levels checked, and any low areas corrected (see above). This should be followed with an even top dressing of new surfacing material over the whole court, applied at a rate of approximately one tonne per court. The surface should then be lightly drag-matted, watered and rolled. Thereafter, normal maintenance routines with

somewhat more frequent rolling initially will produce the new playing surface for the coming season.

3.5.11.2 French Clay

The surface layer consists of decomposed limestone, which is buff or grey in colour, top-dressed with bright red, fine top dressing. The surface is laid to a significantly greater thickness than is usual for other types and is very moisture retentive. It is also relatively slow draining. Routine watering, therefore, needs to be carefully controlled and should not be over-done. Only sufficient water should be applied to re-soak that part of the surface that has dried out and no more. If excess water is applied it may lie on the surface and delay play. Should the whole surface layer have been allowed to dry out completely, then watering will indeed have to be more copious and prolonged and the courts may not be ready for use for some hours.

Because of the relatively slow drainage rate, it is important to maintain very accurate surface levels, so that puddles do not form. The coin test is a good one. If standing water is deeper than, say, a two pence piece, the area should be top dressed with the fine red material. Fine top dressing should not be applied in large quantities at any one time. Two or three bags per application per court should be sufficient.

If puddles do persist, the water can be dispersed by boring through the surface layer into the foundation with a large nail or fine-tined fork. The low area should then be eliminated by top dressing.

The need for frequent watering in hot, dry weather can be reduced somewhat by using calcium chlorate as a deliquescent. The court should first be watered copiously until the water shows signs of standing. The calcium chlorate should then be applied evenly over the surface at a rate of 100 kilos per court. The court should be kept out of action for a full day before play recommences.

Routine Maintenance

At The End of the Day

At the end of the day after play has finished, the whole surface should be drag-matted, having first carefully repaired any holes or damage with the foot or a loot. The play-lines should then be swept and the court watered evenly and generously, but stopping before the water begins to stand. The surface will begin to "shine" when sufficient water has been applied.

Before Play Commences

Before play commences the surface should be drag-matted again, sweeping the lines and watering the surface lightly if it shows signs of drying out.

If warm dry conditions persist during the day, it may be necessary to water again lightly, once or twice. An efficient sprinkler system should apply sufficient water in about two minutes.

Preparing the Court for winter

With the first frost of autumn, the court must be put out of use until next season. Plastic lines should be carefully lifted, washed and stored for re-use. If the lines have been painted they should be chipped off with a shovel and discarded. As much as possible of the red surface grit should be swept to the perimeter with a birch besom or similar, and discarded.

During the winter the surface will become puffed up and waterlogged after rain. It should not be walked on in this condition.

Restoring the Surface after the winter

As soon as the risk of heavy frost is past (usually not before the end of April), the limestone layer has to be painstakingly broken up using a hand scarifier, rake and other suitable equipment, ensuring that the whole limestone layer down to the foundations is treated, but without mixing foundation material into the limestone. The initial effect will be to produce a very lumpy surface. These lumps then have to be broken down with the rake, taking care at all times to preserve the general level. Then a good level and an initial degree of compaction must be achieved with a loot.

Rolling can now commence in alternate directions - two or three times in each direction.

Levels should be adjusted with the loot as the rolling proceeds.

Once the final level has been achieved, together with partial compaction, top-dressing with red fine top-dressing can commence. 300 kg per court at a time should be dressed evenly over the entire surface.

The surface should then be well watered until puddles begin to form. When they have drained away the court should be rolled once in each direction.

The top-dressing should be repeated twice more so that approximately one tonne of dressing will have been applied per court.

Final adjustments to the levels and top-dressing can then take place, followed by a further rolling when the court has dried.

The play-lines can now be re-laid in accordance with the manufacturer's instructions. The play-lines can also be painted, but only by applying an initial coat of boiled linseed oil before using white line paint. At least two coats of line paint are usually required.

At least two days should elapse after the completion of this restoration work and line-painting, before play commences. Initially play should be carefully controlled and the performance of the surface carefully monitored.

3.5.11.3 UK Shale or Blaes

This surface was once the dominant tennis surface in the UK. It was not until the 1930s that the so-called “all-weather” surface began to make significant progress. After the Second World War, however, the high cost of maintaining the “En-tout-cas” surface resulted in it being systematically replaced at most venues until today relatively few remain, and even fewer are still maintained in good condition.

Shale courts differ from both American fast-dry and continental clay in having a more coarsely graded surface layer. This greatly assists drainage, and thus increases frost resistance. This allows the surface to be kept in play during frost-free weather throughout the winter, something that cannot be done so easily with the overseas products. Unfortunately the presence of the coarser particles in the surface layer also renders the surface much more demanding of skilled and regular maintenance; without it the surface soon becomes gritty, slippery and unpleasant to play on.

A further difficulty is the declining availability of good top dressings for maintenance purposes. Nevertheless some courts remain - a few still in excellent condition.

General Maintenance

The most desirable surface is one that is firm, level, free of grit and slightly damp. Except in special circumstances this is the surface condition that should be achieved during the summer playing season. In winter it is usual to prepare a somewhat grittier surface.

The routine maintenance procedure starts after the courts have been used and need to be restored before further play. The first stage of the “repair, water, brush, roll” cycle should be carried out as soon as possible after play has finished, typically in the evening. This enables full advantage to be taken of any overnight rain. If heavy rain falls on a badly disturbed surface, the subsequent repair process will be significantly more difficult.

Repair

All disturbed areas should be quickly repaired by pushing and pulling the loot over them to leave holes filled and bumps levelled. Loose material pulled into depressions should be lightly tamped with the back of the loot.

If the damage is minor the loot may not be needed at all, and going over the whole court once or twice with a drag broom (usually the soft one), or a drag mat is all that is necessary.

Whether or not the loot is needed, drag-brushing or drag-matting is the operation that precedes watering and rolling (or just rolling if the material is moist enough).

If there is foreign matter on the surface, such as leaves, or large grit in excess, then some of it can be removed by lifting the brush away at the end of the court and looting off the ridge of grit and debris left behind. Occasionally, deeper holes may need repairing, usually at the baseline. Looting material into these may not be successful because this material will tend to be gritty and loose and soon comes out again. If this is the case, the holes should be made up with a little new medium material, tamping lightly before watering. If the base of the depression is smooth it is important to scarify it lightly with a fork to give a key for the new material.

The repair of larger depressions or areas of damage is dealt with elsewhere.

The most important thing of all is to perform this repair operation as soon as possible after play has ceased.

Watering

The shale surface drains more rapidly than either American fast-dry or continental clay and can be watered more copiously. Indeed, it is particularly important to apply sufficient water to soak completely through the surface layer. The surface is also more vulnerable to damage by careless watering or badly maintained sprinkler equipment, which can wash away the fine surface skin and expose the grittier material below.

It should be remembered that rain is the best watering system of all. It is well worth repairing the surface in plenty of time to take advantage of it.

Brushing

After watering and before rolling the surface should normally be brushed lightly with the soft broom.

Rolling

The court should now be rolled, making sure that the surface is not too wet and therefore too sticky, nor too dry when rolling will be much less effective.

Following rolling and any final tidying up, the court should be ready for play.

Top Dressing

The preferred surface for play is fine in texture with no loose, larger grit on the surface. This will involve top-dressing from time to time with fine dressing. Loose grit on the surface must either be removed altogether (if it is worn and rounded), or rolled back into the surface. Thereafter the secret is to top-dress little and often, ensuring that the fine top-dressing forms a continuous playing surface, suppressing the coarser grit in the process. If too much top-dressing builds up the surface may become sticky and slow draining. If this occurs then more vigorous brooming than usual should break the skin and re-incorporate the excess fine dressing with the larger material, (if necessary when the surface is dry). In extreme cases, judicious top dressing with medium material may be necessary.

A single top-dressing should not involve more than three 50kg bags of fine dressing. A skilled person can broadcast this thinly and evenly with a shovel, but someone less experienced may prefer to do it by hand or with a fertiliser distributor.

It is usual to apply fine dressing before watering an already damp surface top dress before brooming and rolling.

Fine material should not be used to build up levels; medium material should be use for this purpose. Otherwise, medium is not usually applied during the playing season except to counteract stickiness (see above).

Repairing Damaged or Low Areas

From time to time, for a variety of reasons, low areas will occur on the surface of the court. These may be quite extensive and shallow caused by settlement or wear, or they may be very localised and quite deep, usually on the baseline or other points of heavy localised wear. Occasionally the problem may be damage caused by a heavy object falling on the surface or careless use of maintenance equipment. It may, for example, be necessary for an oily patch to be removed.

If possible the treatment of large, shallow depressions should be left to the end of the season (or the beginning of the next). However, small, deeper areas must be dealt with straightaway. The procedure is as follows.

Firstly, the area to be treated should be delineated. Then the whole area to be lifted should be raked or forked (using the point of the tines only), to give a thorough and positive key to the new material.

The new medium should now be added, using a straight edge of the appropriate length (or the blade of the loot if the area is very small), to gauge the right amount, striking off the surplus.

When an even application of new medium has been applied, the material should be rolled or lightly tamped while it is still dry. Then, checking with the straightedge again, more medium should be added if required, and the process repeated.

Normal maintenance of the whole court can then recommence. It is important to remember that until it is fully integrated the new patch will be "tender". It will therefore need rather more watering and rolling and less matting or brooming than the remainder of the court.

If the area is deep or if there is any indication that the "key" is suspect, the new dry material should be forked right through into the old surface below, covering the whole area at very close centres, (holes 1 inch apart). This will achieve an even better join between the new and the old.

Repairing a Flaked or Sheared Surface

This is one of the most difficult problems that are likely to be encountered. It is caused when a shear line develops between the surface layer and the foundation, or within the surface layer itself. Whatever the cause and wherever the shear-line the result is the same. The uppermost part of the surface becomes more or less permanently detached and will not re-attach itself automatically. The visual indication of "flaking" is close, horizontal, parallel, wavering cracks in the surface which are usually noticed after the roller has passed. No amount of rolling will correct the situation. Sideways pressure with the foot will result in the unattached layer being pulled off altogether. A player running to return a deep shot, stopping or turning on a flaked layer will lose all grip and displace deep divots.

The condition is usually induced by careless or clumsy use of the roller. Rolling when there is still some frost left lower down in the surface layer is another classic way of shearing the surface. A roller that is too heavy can also induce this problem.

When a small area becomes sheared, the condition will tend to spread if it is not dealt with quickly.

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There is no quick and easy way of dealing with this problem. The affected area should be marked out, then be carefully forked at very close centres with a sharp tined fork. The tines must penetrate through the loose upper layer and into the hard lower layer over and over again so as to create a new "key", whereby the upper layer will re-adhere to the lower. The process is tedious but must not be skimped. Indeed, it may have to be repeated, if the first pass is not fully effective.

When the whole area has been forked it should be very lightly broomed, carefully rolled (initially with a hand roller), and then checked to ensure that process has been effective. Prevention is very much easier than cure.

Standing Water

Water may begin to stand on the surface after heavy rain. This suggests that the fine top layer is too thick and over-compacted. The temptation to spike through into the foundation layer with a fork or large nail should be resisted if play needs to start imminently, because the surface may break up as a result. It is better to soak up the water with old blankets or similar. The blankets can then be squeezed out into a metal wheelbarrow. If done with care the surface will be undamaged and play can re-commence very quickly. The blankets should not be dragged, as this will disturb the surface.

In due course the root cause of the slow drainage must be tackled.

Winter Use

As already stated, the shale court can be used in open, frost-free weather during the winter, but the maintenance required should be varied to make this possible.

It is advisable to create a grittier surface for winter play. This can be done by "gritting-up" the summer surface, for example by brushing it when dry, or very lightly raking it with a springtime rake. Medium dressing may also be added at a rate of approximately three 50kg bags per court. Top dressing with fine material must be discontinued.

After heavy frosts the surface will become puffed up and if left in this condition any subsequent rain will wash the fine particles through, leaving the surface far too gritty and storing up problems for the future. To prevent this, the surface should be rolled after frost, but not until all the frost has thawed and the surface has dried and ceased to be sticky. The rolling should be carried out in alternate directions.

Winter Closedown and Maintenance

If the court is not required during the winter months, or if it has become over-compacted and slow-draining, it should be put out of use at the end of the season and a programme of pre-winter maintenance carried out.

Firstly the whole surface should be checked for levels and any low areas corrected (see above).

The line tapes can then be removed. If the surface layer has become too thin, medium dressing can now be added to correct this.

The whole surface must now be carefully broken up using a thin-tined fork at very close centres. The surface material should be broken up by this operation but not displaced. This operation will also thoroughly incorporate any new medium that has been added. This is a slow and laborious

procedure, but it is essential that it should be carried out most years if the court is to remain in good, free-draining condition. It is not usually necessary, however, in the first few years of a new surface's life.

Should it be judged that the surface material is too fine and dirty, as may happen on old or heavily used courts, "winter medium" may be added at this stage. This is medium dressing from which all fine material has been removed. It should be used sparingly, for example four to six 50 kg bags per court.

The surface, when sufficiently broken up, can then be lightly rolled and left to weather down further. Winter wind, rain and frosts will continue the process of breaking down and revitalising the surfacing material. It is important that the surface be lightly rolled in a transverse direction whenever there has been heavy frost to prevent rain washing the fine particles through.

Pre-Season Maintenance

Spring restoration can start when it is judged that the worst of the winter is past, typically in late March.

It is best to remove the line tapes before starting the restoration programme. The court surface itself may look a mess, so the first step is to remove any detritus or foundation material brought to the surface by frost action. This is best done first with a rubber rake, and then, if necessary, with the loot. The surface levels should be checked, and any low areas corrected.

The whole surface should now be top-dressed evenly with medium dressing. About five 50kg bags per court should be sufficient. This should be followed by brooming the court with a medium broom in both directions, then rolling in both directions.

The surface should now be top dressed very carefully and evenly with fine dressing,(about three 50 kg bags per court), then watered, brushed and rolled. If the surface is still too gritty, the fine dressing will need to be repeated, watering, brushing and rolling again. It is important not to apply too much fine dressing too quickly. Finally, the line tapes should be replaced.

The newly restored surface now needs to be observed carefully, top-dressing and adjusting as required until the required texture and degree of firmness is achieved. To begin with the surface may be a little tender, and the grounds man's instructions should be followed carefully.

3.5.11.4 Other Water-Bound Surfaces

Other similar water-bound surfaces may still exist in small numbers. Courts made from crushed rock of UK origin are the most common and have proprietary names such as "Griselda", "Dripla" and "Red-gra". In Scotland "blaes" courts are made from the crushed, burnt shale, which is to be seen in great heaps in the central industrial areas. All of these and various other similar surfaces may be maintained by following the general principles set out in this Code of Practice. Their particular peculiarities and requirements must be a matter of both experience and trial and error.

3.6 Maintenance of Polymeric Courts

3.6.1 Introduction

Polymeric tennis courts consist of a permeable foundation of crushed, graded stone, topped with porous macadam and a playing surface made from a coloured polyurethane binder and rubber crumb or powder, applied directly to the macadam, or to a polyurethane and rubber cushion layer. The play-lines are painted on the surface.

The resulting surface gives a medium to slow paced game, is free-draining and playable throughout the year, and requires very little maintenance. Depending on the system used the surface also has a distinctly "cushioned" feel underfoot.

The small amount of maintenance required is, nevertheless, very important if the court is to provide a good quality game and is to remain free-draining for its expected lifespan. Indeed, the installer's guarantee is likely to be dependent upon the maintenance recommendations being carried out with reasonable efficiency.

3.6.2 What Maintenance and Why

The maintenance procedures are designed to ensure that:

- The playing surface is kept scrupulously clean;
- The free drainage of surface water remains unimpaired throughout the life of the court;
- Moss and algae are not allowed to grow on the surface;
- The court looks attractive and well cared for at all times and provide a good surface for playing tennis whenever required; and that
- The court achieves its intended lifespan.

These objectives are achieved by:

- Sweeping or vacuuming leaves and other detritus from the surface;
- Occasionally washing the surface; and
- Applying prophylactic treatments of moss-killer and algaecide.

3.6.2 Keeping the Surface Clean

Leaves, tree flowers, pine needles, fluff from tennis balls and other detritus should not be allowed to remain on the surface for any length of time. If this does happen they rapidly rot down and settle into the interstices of the surface impairing drainage and providing a growing medium for algae and moss.

A wide soft broom can be used to sweep the surface but this has a tendency to push smaller material into the surface. A rubber-tined rake is usually better, albeit rather slow and arduous. Best of all is a mechanical garden vacuum cleaner, which will greatly speed up the operation and do it more efficiently. Mechanical leaf sweepers can also be good. The equipment should

be well maintained and carefully operated to avoid contamination of, or physical damage to, the surface.

At least once a year the court surface will benefit from a vigorous wash. This not only has the effect of keeping the surface interstices clean and free-draining, but is also essential for maintaining good foothold. Courts near busy roads are particularly susceptible to becoming coated with “traffic film”, whilst those near trees may become coated with “honey-dew” from aphids. The resulting black film from either cause can make the courts very slippery after rain.

If the water pressure is reasonably high, washing can be carried out with a domestic hosepipe assisted by a mild cold water detergent. Even more effective are the cold water pressure washers that are available from most equipment hire outlets. These, however, must be used with care, the greatest attention being paid to establishing that the process does not dislodge the coloured surface coating. Again a mild, non-foaming detergent increases the efficiency of the operation. Steam cleaners should not be used. If the court surface has become very badly sealed and does not respond satisfactorily to this treatment, the installer or a firm that specialises in cleaning tennis courts should be consulted.

3.6.3 Moss and Algae

In certain situations and in some seasons algae or moss can become established on the court surface. Since prevention is very much more effective than cure, it is important to treat the court with a good proprietary moss-killer and algacide at least once a year. Particular attention should be paid to those perimeter and other areas that are not trafficked, especially if they are shaded by walls or buildings or overhung by trees. Any good proprietary product should be satisfactory provided that it is not oil-based. The manufacturer's instructions should be closely followed. Some installers can supply specially formulated moss-killers.

Should moss become established it should be treated immediately, the application being repeated until the moss can be brushed or vacuumed away. In the case of very severe infestation, the installer should be consulted.

It should be emphasised that moss is only a serious problem if it is allowed to become established. An annual prophylactic application of moss-killer is an easy way of preventing this. Keeping the surface free of vegetable debris on a regular basis renders moss an even less likely problem.

3.6.4 Snow and Ice

Snow and ice should not prove to be harmful and can be allowed to melt through in due course. Powdery snow can be swept away using a wide soft broom or wooden scraper. Metal shovels or scrapers should not be used because they may damage the surface, as will mechanical snow removing equipment, such as mini tractors.

Salt, urea or other chemical de-icing agents should not be used. Their effect is unpredictable and they can cause severe damage.

3.6.5 Re-colouring the Surface

Re-spraying the surface is a very skilled operation and should not be attempted except by the installer or a specialist company.

3.6.6 Play-Lines

Play-lines can be repainted by brush when required, using the line paint recommended by the installer.

3.6.7 Maintenance Schedule

Daily - at the end of the days play.

- Make sure the net is slackened and rolled up in the middle.
- Make sure the gate is shut.

Weekly

- Clear leaves and rubbish from the court.

Monthly

- Deal with any moss or algae.

Annually

- Wash the court.
- Apply moss killer.
- Call in the installer if any aspect is causing significant concern.

Note:

These are minimum recommendations. Common sense and careful observation should prevail. If any serious doubt exists about the effectiveness of the maintenance regime or the condition of the court, the installer should be contacted. It is better to be safe than sorry.

3.7 Maintenance of Porous Concrete Courts

3.7.1 Introduction

Porous concrete tennis courts consist of a permeable foundation of broken graded stone on which is laid the porous concrete playing surface. The surface is laid in sections or slabs each measuring approximately 20 feet by 10 feet and 3.5 inches in thickness. Between the individual sections is expansion jointing material to absorb the slight expansion and contraction typical of concrete. Unlike ordinary concrete, a “no-fines” mix is used which results in a fine, smooth honeycomb texture, which is fully porous. The playing surface will be pigmented, but is usually also colour sprayed. The play-lines are painted onto the surface.

The resulting court gives a very true and consistent slow to medium paced game. It is free-draining, playable throughout the year and very robust. It requires very little maintenance, but the maintenance that is needed is vitally important if the court is to provide a good, safe game and to remain free-draining for its expected life span. Indeed, the installer's guarantee is likely to be dependent upon the maintenance recommendations being carried out with reasonable efficiency.

3.7.2 What Maintenance and Why

The maintenance procedures are designed to ensure that:

- The playing surface is kept scrupulously clean;
- The free drainage of surface water remains unimpaired throughout the life of the court;
- Moss and algae are not allowed to grow on the surface;
- The courts look attractive and well cared for at all times and provide a good surface for playing tennis whenever required; and that
- The court achieves its intended lifespan.

These objectives are achieved by:

- Sweeping or vacuuming leaves and other detritus from the surface;
- Occasionally washing the surface; and
- Applying prophylactic treatments of moss-killer / algacide.

3.7.3 Keeping the Surface Clean

Leaves, tree flowers, pine needles, fluff from tennis balls and other detritus should not be allowed to remain on the surface for any length of time. If this does happen they rapidly rot down and settle into the interstices of the surface, impairing drainage and providing a growing medium for algae and moss.

A wide soft broom can be used to sweep the surface but this has a tendency to push smaller material into the surface. A rubber-tined rake is usually better, albeit rather slow and arduous. Best of all is a mechanical garden vacuum cleaner, which will greatly speed up the operation and do it more efficiently. Mechanical leaf sweepers can also be good. The equipment should be well maintained and carefully operated to avoid contamination of, or physical damage to, the surface.

At least once a year the court surface will benefit from a vigorous wash. This not only has the effect of keeping the surface interstices clean and free-draining but is also essential for maintaining good foothold. Courts near busy roads are particularly susceptible to becoming coated with “traffic film”, whilst those near trees may become coated with “honey-dew” from aphids. The resulting black film from either cause can make the courts very slippery after rain.

If the water pressure is reasonably high, washing can be carried out with a domestic hosepipe assisted by a mild cold water detergent. Even more effective are the cold water pressure washers that are available from most equipment hire outlets. These, however, must be used with care, the greatest attention being paid to establishing that the process does not dislodge the coloured surface coating or stone chippings. Again a mild, non-foaming detergent increases the efficiency of the operation. Steam cleaners should not be used. If the court surface has become very badly sealed and does not respond satisfactorily to this treatment, the installer or a firm that specialises in cleaning tennis courts should be consulted.

The court surface should be inspected regularly for minor damage. Any small unsightly areas can be touched up using the appropriate surface paint obtained from the installer. Completely re-spraying the surface, however, is a very skilled operation and should not be attempted except by the installer or a specialist company. Play-lines can be repainted by brush when required, using the line paint recommended by the installer.

3.7.4 Moss and Algae

In certain situations and in some seasons algae or moss can become established on the court surface. Since prevention is very much more effective than cure, it is important to treat the court with a good proprietary moss-killer and algaecide at least once a year. Particular attention should be paid to those perimeter and other areas that are not trafficked, especially if they are shaded by walls or buildings or overhung by trees. Any good proprietary product should be satisfactory provided that it is not oil-based. The manufacturer's instructions should be closely followed. Some installers can supply specially formulated moss killers.

Should moss become established it should be treated immediately, the application being repeated until the moss can be brushed or vacuumed away. In the case of very severe infestation, the installer should be consulted.

It should be emphasised that moss is only a serious problem if it is allowed to become established. An annual prophylactic application of moss-killer is an easy way of preventing this. Keeping the surface free of vegetable debris on a regular basis renders moss an even less likely problem.

Note:

Moss is the greatest enemy of porous concrete surfaces, slowing drainage and initiating frost damage. Moss prevention is the most effective single action to prolong the life of these surfaces.

3.7.5 Movement of the Sections

It is of the nature of concrete that it expands and contracts with variations in temperature and moisture content, and the porous concrete sections used to construct this type of tennis court are no exception. However, the size and layout of the sections and the expansion jointing material will all have been designed with this in mind. Thus such movements that do occur on porous concrete tennis surfaces are usually imperceptible and easily accommodated within the design. Just occasionally, however, the effects of expansion may be apparent for short periods, such as in the cool of the evening after a very hot day when the differential cooling of the sections may cause them to lift slightly at the corners. This effect should have dissipated by the following morning. No action is therefore required or should be attempted.

Should differential movement of the individual sections occur resulting in significant steps between them, the installer should be contacted.

Hair cracks may become apparent on older surfaces, but these are usually characteristic of this type of surface and need not cause concern, nor do they necessarily constitute a defect. If, however, pronounced cracks appear, then the installer should be contacted.

3.7.6 Snow and Ice

Snow and ice should not prove harmful and can be allowed to melt through in due course. Powdery snow can be swept away using a wide soft broom or wooden scraper. Metal shovels or scrapers should not be used because they may damage the surface, as will mechanical snow removing equipment, such as mini tractors.

Salt, urea or other chemical de-icing agents should not be used. Their effect is unpredictable and they can cause severe damage.

3.7.7 Maintenance Schedule

Daily - at the end of the days play

- Make sure the net is slackened and rolled up in the middle
- Make sure the gate is shut.

Weekly

- Clear leaves and rubbish from the court.

Monthly

- Deal with any moss or algae.

Annually

- Wash the court.
- Apply Moss killer
- Call in the installer if any aspect is causing significant concern.

Note:

These are minimum recommendations. Common sense and careful observation should prevail. If any serious doubt exists about the effectiveness of the maintenance regime or the condition of the court, the installer should be contacted. It is better to be safe than sorry.

3.8 Maintenance of Grey-Green Courts

3.8.1 Introduction

Grey-green tennis courts usually consist of a permeable foundation of broken, graded stone (it may be ash or clinker under old courts) on which is laid the porous, bitumen-bound wearing course. This in turn is dressed with a fine grey-green grit from which this type of court gets its name. Some of the grit will adhere to the bitumen but some will form a loose top dressing. The play-lines are painted onto the surface.

The resulting court requires relatively little maintenance in comparison to clay and shale surfaces, but the maintenance requirement is nevertheless essential if the court is to perform

well and achieve its designed life. Indeed, the installer's guarantee is likely to be dependent upon the maintenance recommendations being carried out with reasonable diligence.

3.8.2 What Maintenance and Why

The maintenance procedures are designed to ensure that:

- The playing surface is kept clean at all times;
- The free drainage of surface water remains unimpaired throughout the life of the court;
- Moss is not allowed to grow on the surface;
- The loose surface grit is kept evenly distributed, whilst leaving the play lines clear and fully visible;
- The court looks attractive and well cared for, and provides a good surface for tennis when required; and that
- The court achieves its intended lifespan.

These objectives are achieved by:

- Sweeping leaves and other detritus from the surface;
- Brushing the surface to keep the loose grit evenly distributed;
- Applying moss killer annually; and
- Rolling the surface each spring.

3.8.3 Keeping the Surface Clean

Leaves, tree flowers, pine needles, fluff from tennis balls and other detritus should not be allowed to remain on the surface for any length of time. If this does happen they rapidly rot down and settle into the interstices of the surface impairing drainage and providing a growing medium for algae and moss.

A wide soft broom can be used to sweep the surface but this has a tendency to push smaller material into the surface. A rubber-tined rake is usually better, albeit rather slow and arduous.

Mechanical garden vacuum cleaners and leaf sweepers may also be used, and they will speed up the operation significantly. They do have the disadvantage, however, of removing surface grit (especially the vacuum cleaners), and should be operated in such a way as to minimise this. The equipment should be well maintained and carefully operated to avoid contamination of or physical damage to the surface.

If any moss growth appears a good proprietary moss-killer should be applied to the surface. Particular attention should be paid to shaded, non-trafficked areas. Provided the surface grit is brushed regularly moss should not prove to be a problem on this type of surface, but an annual application of moss-killer is a worthwhile precaution.

3.8.4 Brushing the Grit

The surface grit will require brushing from time to time, the frequency depending upon how much the court is used. This will greatly improve the appearance of the court by removing footmarks and will ensure an even distribution of the grit to optimise playing conditions.

A wide broom with soft or medium stiff bristles is ideal for this purpose. It should be dragged rather than pushed. The brooming should be a continuous process, the brush remaining on the surface when the surround fence is approached and being turned through 180 degrees without its forward progress being checked. Stopping and lifting the brush to reverse direction will leave unsightly and inconvenient ridges of grit. It is also good practice to alternate the direction in which the court is broomed, i.e. lengthways brooming should be followed by carrying out the process across the court.

Brushing the court will inevitably result in grit remaining on the play-lines and partially obscuring them. The play-lines should therefore be brushed clean using a special narrow brush or small mechanical cleaner made for the purpose.

Occasionally it will be necessary to add a little extra grit to replace natural wastage. It is usual to do this in the spring, but it can take place at any time of the year. Extra grit should only be added in small quantities, such as three to five bags at a time, taking care to ensure even distribution by brooming. Care should also be taken to avoid excess grit, which may impair foothold.

3.8.5 Commissioning the Court in spring

To commission the court for the season's play, it is recommended that it be rolled during early spring using a garden or pedestrian roller. The court should first be cleaned of all surface detritus. Rolling should not be carried out in very cold weather when the bitumen binder will be brittle; it is better to wait for a warmer day. This operation is usually only required during the first half of the court's life, i.e. for four or five years. Thereafter rolling will be less effective.

3.8.6 The Post-Construction Phase

The grey-green surface, in common with all bitumen-bound surfaces, has a tendency to soften during spells of hot weather during the early part of its life. If this occurs play should be suspended until the surface has cooled down and hardened. Failure to take this precaution can result in damage to the new surface causing it to become uneven and less porous.

This softening effect is only a passing phase, usually confined to the first season or two after construction, and is rare thereafter.

3.8.7 Frost, Snow and Ice

In very cold weather the bitumen binder will become brittle and play should be suspended to avoid damage to the surface.

Similarly snow and ice should be left in-situ and be allowed to melt away naturally. Salt or other chemical de-icing agents should not be used.

3.8.8 Play-Lines

Play-lines can be repainted as required using line paint recommended by the installer.

3.8.9 Maintenance Schedule

Daily - at the end of the days play

- Make sure the net is slackened and rolled up in the middle.
- Make sure the gate is shut.

Weekly

- Clear leaves and rubbish from the court.
- Broom the court surface to re-distribute grit. Clean the play-lines (the frequency of this operation will depend on the frequency of use of the court).

Monthly

- Deal with any weeds or moss.

Annually

- Roll the court in spring.
- Apply moss-killer.
- Add surface grit if required.
- Call in the installer if any aspect is causing significant concern.

Note:

These are minimum recommendations. Common sense and careful observation should prevail. If any serious doubt exists about the effectiveness of the maintenance regime or the condition of the court, the installer should be contacted. It is better to be safe than sorry.

4 Section Four - Renovation & Reconstruction

4.1 Introduction

Resurfacing an existing tennis court with the same surface, renovating, may be a straightforward operation, especially if the court is relatively modern and in good condition. **Older courts may need more general upgrading of the underlying construction, if the cost of replacing the playing surface is to prove a good investment.**

Changing the surface to another type may have implications that are even more far-reaching and if the court is old as well, the re-construction work involved may well differ little from the construction of an entirely new court.

Before the optimum specification can be decided, it is essential to carry out a detailed inspection of the court to be renovated or reconstructed. This should include checking its size, gradient and levels. Where appropriate and practical, the depth and specification of the sub-base should also be examined, together with the condition of the edgings, net-post sockets and fencing. Where the surface tolerance of the surface raises doubts as to the stability of the existing base construction, a site investigation with trial holes through to formation level will be required.

4.2 General Considerations

Following the inspection, it will be necessary for the parties to agree the extent of any works that are to be carried out in conjunction with the resurfacing. Some of these may be tackled most conveniently at the time of resurfacing, whilst others may become necessary as a direct result of the resurfacing.

In addition, the conscientious installer will wish to bring to his client's attention any aspects of the existing court which are defective, not up to modern standards or out of line with current recommendations. It can then be decided whether these aspects are to be upgraded at the time of resurfacing, or whether the client is content for the court to be resurfaced as it is.

Significant aspects to be considered may include some or all of the following.

4.2.1 Dimensions

In the early days of tennis court construction, the full Davis Cup size of 36.567m x 18.288m (120ft x 60ft) was frequently adopted. Depending on the standard of play that is to be catered for, it may be possible to achieve significant cost savings by a modest reduction in size, especially if an old netting surround is also to be replaced. Similarly, it may be desirable to increase the size of the court, to bring it into line with current recommendations.

4.2.2 Gradient

Changing the surface, such as from porous macadam to impervious acrylic, could necessitate increasing the gradient of the court to assist surface water run-off. Alternatively, it may be appropriate to reduce an excessive gradient. In the absence of a specific agreement to the contrary, it is normal practice to assume that the existing gradient is to be maintained when resurfacing.

4.2.3 Edgings

It may be necessary to provide new perimeter kerbs or edgings, either because the existing edgings are in poor condition or because the new playing surface is to be laid to a different, (usually higher), level.

As an alternative to new edgings, it is sometimes possible to superimpose a thin paving tile or similar on top of existing edgings which are otherwise sound. It is also possible to "feather" the new, higher surface down to the level of the existing edging but this can only be recommended when the difference in level is small (e.g. when resurfacing grey-green with grey-green) and where the workmanship is of a high order.

Generally, it is a false economy to try to retain existing edgings if there is any doubt as to their condition or level.

Edgings should, as a general principle, be laid flush with the finished court surface. Any up-stand at the edgings creates a hazard and potential trip edge.

Altering the level of the court surface and edgings usually involves adjustments to the gates in the surround fencing.

Where edgings are replaced or raised, it is important to avoid creating a trough between the new edging and the surround fence into which balls will fall, making their retrieval difficult, and where a player might trap their foot or trip.

4.2.4 Net Post Sockets

An alteration in the level of the playing surface will necessitate the adjustment of the net-post sockets so that the effective height of the net remains correct. If the sockets are in good condition, it is possible to fit a spacer or extension piece which will raise the posts by the required amount.

If any doubt exists as to the condition or setting-out of the existing sockets, it is usually better to replace them altogether. This will become necessary, in any case, where old sockets do not match new net-posts.

4.2.5 Surround Fence

Every effort should be made to replace unsightly and defective surround fences at the time of resurfacing or reconstructing a tennis court, especially if the posts are badly rusted and likely to require replacement within the life of the new surface. Replacing fence posts may cause disruption to the edgings and the court surface. In addition, much of the benefit of a good quality, good looking new surface can be lost if it is to be surrounded by unsightly and defective old fencing.

If the fencing is basically sound, it may, nevertheless, be appropriate to carry out minor repairs and routine maintenance e.g. re-painting, replacing or re-tensioning straining wires etc.

The use of sight-screens or wind-screening materials attached to the surround fence has become more popular, especially at clubs. If this is likely to be a requirement, the installer should be asked to advise on the suitability of the existing fence for this purpose.

4.2.6 Weed Killing and Moss-Killing

Small numbers of weeds on the existing surface should present no problem, and may be dealt with in the normal way. A heavy infestation of the old surface, however, especially by tree suckers, mare's tail, polygonum etc., merits much more serious consideration, because their elimination may be a more protracted and difficult operation than would be the case on a virgin site. It is recommended that specialist advice be taken on the selection and application of the correct herbicides, and that a sufficient interval be allowed before resurfacing work commences to establish that all weeds have been eliminated.

Where an existing surface is being retained as a base for the new or renovated surface, any contamination by moss should be removed. The moss should be killed with a proprietary moss-killer and removed using high-pressure water jets.

4.2.7 Tree Roots

Tree roots that have given rise to suckers should be cut off outside the court and removed as far as possible from under the court. The provision of a root-trench should be considered. Great care must be taken when cutting roots of live trees and professional advice should be sought to ensure that the tree is not killed off, or rendered unstable, by the root removal.

4.2.8 Drainage

A common indication that an existing surface is in need of renovation is the presence of surface water long after rain has ceased to fall. Surfaces, which were designed to be porous when new, gradually seal due to clogging of the pores in the surface. The existing drainage system should be checked to ensure that, if the court is renovated with a new, porous surface, the base and the out-fall drains are able to cope with this water.

4.3 Renovation and Reconstruction

As outlined above, there are a number of general considerations that may result in extending the scope and extent of the work involved in resurfacing a tennis court. In the following pages each of the standard types of tennis court are examined to establish the likely implications of the choice of a new surface. It will be seen that resurfacing with the same surface as the existing, renovating, is usually relatively straightforward, but that the decision to specify a different surface, reconstruction, can have far reaching implications, and that what starts out as an apparently simple decision to change a surface can result in a major reconstruction of the court.

To ensure the court following renovation or reconstruction is suitable for the game and type of surface all renovation or reconstruction works should be undertaken to the same standards and tolerances as used for new courts (see Section 3).

4.3.1 Resurfacing Porous Macadam Courts

In the UK, macadam courts easily outnumber all of the other types of tennis court put together. Porous macadam courts have been built in large numbers since the mid 1970s and should have adequate crushed stone foundations, as will most ordinary macadam courts, although this should always be checked. However, a small number of old ordinary macadam courts with ash foundations still exist, which will suffer from the same shortcomings as grey-green and will usually require similar procedures to upgrade the foundations prior to resurfacing. With this proviso, the two types of macadam can be treated similarly.

It is also a fact that, macadam construction forms the base for most other tennis surfaces such as artificial grass, polymeric, acrylic, etc. This means that courts, initially installed with macadam finish, may be up-graded to a more sophisticated tennis surface, at a later date. In addition, the comments on macadam renovation and reconstruction will apply to the reconstruction of bases for these other surfaces.

4.3.2 Resurfacing Macadam with Macadam (Renovation)

The major considerations determining resurfacing or reconstruction procedures are:

- The porosity of the existing surface
- The levels of the existing surface.
- The integrity of the existing surface
- The total construction depth of the existing court

To restore porosity (and to assist the adhesion of the new surface to the old), the existing surface should be drilled at 450mm centres, (taking care that the backfill of chippings in the drill holes is flush and well consolidated), thoroughly swept and pressure washed.

The court construction should be checked to ensure that water is not being inherited from the surrounding area. If this is the case perimeter cut-off drainage should be provided.

Lack of attention to the level of perimeter kerb foundations, at the time of original construction, can lead to surface water being trapped in the sub-base structure of the court. This fault will be manifested as slow surface water drainage, despite having drilled the surface as above. Remedial action will entail creating free passage for the water through or under the perimeter kerb foundation.

Prior to resurfacing, the existing surface should be thoroughly rolled with a roller at least as heavy as the one to be used for consolidating the new surface.

If the existing levels are such that, the gap below a three metre long straight edge is less than 15mm, the improvement in surface tolerance should be achieved by the installation of a single new surfacing layer, to clause 2.1.3, as long as the minimum consolidated thickness specified, is achieved.

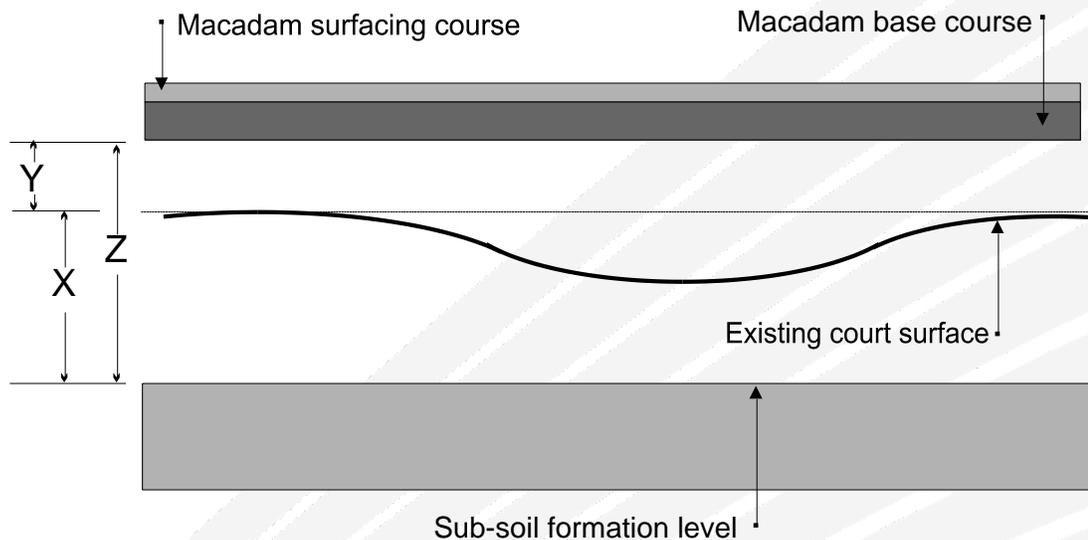
However, if the surface tolerance is not less than 15mm under a three metre straight edge and/or the surface is affected by localised bumps or hollows exceeding 15mm over at least 20% of the surface area, an alternative approach is required.

A bituminous macadam base course will be required to regulate the existing surface levels and help strengthen the unstable surfacing layers. Where depressions in the existing surface are excessive, it may be necessary to apply a regulating layer of bituminous macadam in advance of the base course construction. In extreme cases, it is acceptable to use a dry stone regulating layer to take out undulations before the installation of a two layer surfacing system.

It is good practice to apply a tack-coat of an appropriate bitumen emulsion to the existing macadam before laying the new surface, but this should not be necessary if a base-course is being provided.

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When the investigation of the existing construction thickness demonstrates that the existing court was constructed with an insufficient foundation depth to comply with the recommendations of this code of practice, an additional layer of material must be installed. The thickness of this layer should be calculated from the equation below.



Where:

Z = design depth of sub-base

X = depth of existing court construction (maximum)

Y = depth of stone make-up required

Y is determined from the formula:

$$Y = Z - \frac{X}{N} \quad \text{where } n \text{ is a number greater, or equal, to } 2.00$$

Cracks in the existing macadam should not be a threat to the new surface if the movement, which caused them, has long since ceased. Resurfacing a macadam court on which cracking is still occurring (e.g. because of ground movement) is unlikely to be successful. Vertical cracking, through the surface, indicates a weakness in the sub-grade. The cause of the cracking should be investigated and rectified before renovation proceeds.

4.3.3 Conversion of Dense Macadam or Impervious Acrylic Courts to Porous Constructions

The conversion of either dense macadam or impervious acrylic courts to some form of porous construction is not uncommon as the desire to use courts in all weather conditions increases.

Conversion as opposed to total reconstruction can only be undertaken if the underlying construction of the court will allow the movement of water through it. As the court will have been built without the need to allow water to percolate through them it is possible that the foundation layer is constructed from an aggregate mix that does not have an acceptable rate of water percolation. It is also possible that the base of the court could be concrete or on brown

field sites that an isolating membrane etc was incorporated into the construction. This means that unless a full specification/drawing of the original construction is available it will be necessary to excavate trial holes to determine the construction of the court and its suitability for conversion. In cases where the unsuitable foundation material or other factors are found the only option for conversion is to totally break-out the existing construction and replace with a new porous foundation and macadam surface.

Assuming the foundation material has acceptable porosity and is considered acceptable there are three methods of conversion commonly used:

Pierce and Overlay

The simplest and therefore cheapest way of converting from impervious to a pervious surface is by the piercing of the existing surface, normally at 300mm to 500mm centres, and overlaying with a bitumen tack coat and open-textured macadam surfacing course.

The ability of this method of conversion to provide rapid drainage is restricted to the rate at which water can flow to the holes pierced through the impervious underlying original surface. As the new macadam layer is effectively bonded to the old it will prevent significant lateral flow of water to the pierced holes. As the depth of the new macadam surface is normally between 25mm and 35mm it means that in periods of prolonged rain it is possible that the quantity of water falling onto the court will be greater than the rate at which the water can run to and drain through the pierced holes. This will result in a build-up of water in the new macadam layer and the possibility of ponding on the surface – defeating the objective of the conversion. If a frost follows the rain (or the thawing of snow) the water trapped within the macadam layer can freeze and expand. This expansion will place greater than normal stresses on the macadam and possibly cause premature failure of the surface through localised fretting.

Whilst the option of piecing and overlaying is considered suitable for relatively small areas (e.g. mini-tennis courts) where the quantity of water draining from the area is relatively small the limitations and risks detailed above mean that many funding agencies do not consider this form of conversion suitable for schemes they are supporting.

Drainage Blanket

One way of reducing the risks described above is to impose a drainage blanket of clean free drainage stone onto of the existing construction before surfacing with new porous macadam binder and surfacing courses (as per new courts). The drainage blanket should be at least 50mm thick - the greater its depth the greater the storage capacity to prevent water ponding on the playing surface. As this form of conversion is effectively the construction of a new court on top of the existing, new edgings, post sockets, etc will be required to finish at the new level of the playing surface. This means it is important to assess the impact on the surrounding infrastructure; the new playing surface will be at least 115mm higher than the original surface. This will reduce the effective height of perimeter fencing and its impact on gates, floodlight column inspection covers, draw-pits, etc. needs to be considered.

Planning

An alternative to providing drainage through and constructing on top of the existing impervious surface is to remove it. The impervious macadam layers are normally no more than 70mm thick and can be removed by mechanical planning. Once removed an inspection of the underlying foundation can be made and if necessary steps taken to remove materials considered

unsuitable. New porous materials can then be laid to form the new surface (as per new courts) which will finish at approximately the same level as the original, meaning there is little impact on surrounding infra-structure.

4.3.4 Resurfacing Macadam with Artificial Grass

If the existing macadam is sufficiently level, stable and free-draining, it should be possible to lay a sand-filled artificial grass surface directly upon the existing surface, having first thoroughly cleaned it, preferably by pressure-washing. To improve further the drainage the existing macadam may be pierced at 450mm centres over its entire area, or in areas where the drainage is particularly impaired, such as around the baselines. It is essential, however, that the holes should be very carefully back-filled, and the chippings thoroughly consolidated to finish flush with the surface. It is recommended that the chippings should be bound in place with bitumen emulsion to prevent them being dislodged during the laying of the carpet.

Unless the existing macadam is in first-class condition, it is usual to superimpose a new porous macadam layer to provide a superior sub-base for the sand-filled artificial grass.

When assessing the suitability and integrity of the existing macadam as a base for the new surface, the requirements of section 4.3.1.1 should be complied with in all respects. Artificial grass carpets may well mask major problems in the existing base construction which will only become evident on removal of this carpet.

4.3.5 Resurfacing Macadam with Acrylic

If the existing macadam surface and its foundations are stable, sufficiently level and laid to an appropriate gradient, it may be possible to lay an impervious acrylic surface directly upon it. Some acrylic systems include a levelling/sealing compound which would seal and fill the macadam. It is important to establish that the impervious acrylic system selected is capable of being used in this way. If there is any doubt, a layer of dense bitumen macadam should first be superimposed on the existing surface.

When assessing the suitability and integrity of the existing macadam as a base for the new surface, the requirements of section 4.3.1.1 should be complied with in all respects.

In most cases, however, existing macadam surfaces will not be laid to an adequate gradient to shed rain-water e.g. 1:120 to 1:100, and a relatively major reconstruction will be required to achieve this, the existing surface being sacrificed in the process.

Adequate provision must be made for collecting and disposing of the very considerable volume of water that will now run off the surface during rain.

4.3.6 Replacing an Existing Macadam Surface

As a general principle, it is always better to leave existing macadam layers in situ because this results, inter alia, in a stronger sub-base. Certainly it is usually less costly to do so than removing the existing layer and replacing it.

Nevertheless, it is possible to remove a macadam layer by hand or mechanically, for example with a mini road planer. It is then essential to re-level and re-consolidate the foundations, adding new material if necessary, before laying the new macadam.

When assessing the suitability and integrity of the existing macadam as a base for the new surface, the requirements of section 4.3.1.1 should be complied with in all respects.

4.4 Resurfacing Artificial Grass Courts

4.4.1 Resurfacing Artificial Grass with Artificial Grass (Renovation)

If the existing court has been well constructed and the macadam sub-base has remained level and porous, the old sand-filled artificial grass surface merely has to be replaced with a new one. In doing so it is important not to allow the macadam sub-base to become contaminated, especially by sand from the old surface. No attempt should be made to reuse the sand.

If the macadam sub-base has lost its level or become slow-draining, consideration must be given to replacing it or superimposing a new macadam layer having first restored the drainage of the existing macadam layer (see section 4.3.1.1).

4.5 Resurfacing Acrylic Courts

4.5.1 Resurfacing Acrylic Courts with Acrylic (Renovation)

It is a virtue of these courts that if they are well-specified and well-built in the first place they can be "resurfaced" at relatively very low cost and have a very long life before major work is required.

Resurfacing procedures fall into two main categories.

If the court is in good structural condition but has become worn i.e. is losing colour and texture, it can be restored to "as new" condition by the application of one or two coats of colour-finish material.

Very minor depressions or surface imperfections can be treated prior to this re-colouring; most impervious acrylic systems include products for this purpose.

If the structural condition of the court has deteriorated significantly, it may become necessary to superimpose a new layer of dense bitumen macadam, or to remove the top 25mm or so of the existing macadam sub-base and replace it. A completely new impervious acrylic surface is then built up (see section 4.3.1.1).

4.6 Resurfacing Shale and Clay Courts

The resurfacing of old shale or clay courts causes more problems and controversy than all other surfaces. The temptation is always to leave too much of the old shale or clay, together with ash foundation material, in situ under the new surface, or to cover them with insufficient new frost-resistant foundation material. The result, all too frequently, is the disruption of the new surface in periods of hard frost. Frost susceptible materials **must** be removed or be given sufficient cover of new frost-resistant foundation material.

4.6.1 Resurfacing Shale/Clay with Shale/Clay (Renovation)

If the foundations, whether ash, cinder or stone are in good condition, i.e. sufficiently porous and not badly contaminated with surfacing material, then it should only be necessary to remove and discard the old surfacing material together approximately 25mm of the foundation material.

The remaining foundation should then be raked to level and lightly rolled. A compacted depth of 25mm of new, fine foundation material should then be screeded on and again lightly rolled. The new surfacing material can then be laid.

4.6.2 Resurfacing Shale or Clay Courts with Macadam, Artificial Grass or Acrylic

Shale and clay surfacing material is invariably very frost-susceptible and the best advice is always that it should be removed in its entirety from the site, together with that part of the foundation material which is heavily contaminated with shale or clay.

Shale or clay courts usually have clinker or ash foundations and the latter is often as frost susceptible as the surfacing material. If it is it should also be removed. However, it must be conceded that access and other problems can make the removal of shale, clay or ash from site difficult and costly. The dirtiest, most frost-susceptible sorts should be removed nevertheless.

Where ash quality is rather better, and the shale or clay thickness is very small, it is possible to rotovate the shale or clay thoroughly into the ash, re-level and thoroughly roll to provide a firm level platform on which to construct what is, in effect, a new court.

If frost-susceptible materials are left on site in this manner, then the new foundations which are superimposed on the ash should consist of not less than a compacted depth of 150mm of good quality, frost resistant broken stone. This may have to be increased to 250mm or more in areas that experience the severest winters.

Great care and experience are required in assessing both the frost susceptibility of old clinker and ash foundations, and the depth of new frost-resistant foundation materials that should be superimposed. Suffice it to say that leaving old shale, clay or ash in situ and providing as little as 25–75mm of new stone foundation is a recipe for disaster.

Resurfacing a shale or clay court with macadam, sand-filled artificial grass, impervious acrylic etc. is, in effect, a new construction, where little of the original court can be retained. Indeed, because of the age of most shale and clay courts, the surround fences and edgings are usually in an advanced stage of decay, which merely reinforces the point.

Should a shale or clay court be found to have a good crushed stone foundation which has not become badly contaminated, then this can, of course, be re-used once the shale or clay (together with ash blinding material if present) have been removed.

In the early days of sand-filled artificial grass, attempts were made to superimpose this surface directly upon shale or clay courts. Almost without exception these attempts failed and this practice is **not** recommended.

4.7 Resurfacing Polymeric Courts

4.7.1 Resurfacing a Polymeric Surface with a New Polymeric Surface (Renovation)

If the existing court has been well constructed and has remained level and porous, it is only necessary to superimpose a new polymeric surface. It is important that the existing surface be thoroughly swept, and washed if necessary, removing any loose material in the process. The installer will normally apply a primer coat to the existing surface before laying the new one.

If the existing court has lost its level, or ceased to drain adequately, consideration must be given to laying a new macadam base layer, by removing the existing surface and macadam or by superimposing a new macadam having first restored the drainage, and applied a bitumen emulsion tack coat (see section 4.3.1.1).

4.7.2 Resurfacing a Polymeric Surface with a Different Surface

For most other surfaces, the procedure outlined above should be adopted.

Sand-filled artificial grass may be laid direct onto a polymeric surface if it is clean, level and free-draining.

4.8 Resurfacing Porous Concrete Courts

Porous concrete courts will all be very similar, being constructed in rectangular bays or slabs (approximately 20' x 9') with expansion jointing material between. A problem with this type of court is a tendency for the bays or slabs to move as a result of ground movement, and thermal expansion and contraction. The extent of this movement in each case is the main factor influencing resurfacing procedures. The porous concrete surfacing is usually approximately 100mm in thickness on a crushed stone foundation of approximately 150mm.

4.8.1 Resurfacing Porous Concrete with Macadam

If a very careful examination of the porous concrete surface indicates that little or no movement of the bays has taken place over the years, that the bays are all flush with each other at the joints, and there are no major surface cracks, it should be possible to apply a macadam layer directly on to the porous concrete. Firstly, however, the porosity should be carefully checked and, unless the concrete is very free draining it should be drilled at 500mm centres and the drainage holes thus formed should be carefully back-filled with clean stone chippings. Care should be taken to ensure that the chippings are consolidated and finish flush with the concrete surface.

It will often be found that the expansion jointing material has rotted and disappeared. If this has happened the gaps, approximately 12mm wide, should be filled. Sand and cement may be used for this, or a latex-based floor screeding compound, which can be trowelled into the open joints quite easily. Alternatively, more loose chippings can be carefully brushed into the joints.

When all the preparatory work is completed and the surface has been swept clean, a bitumen emulsion tack-coat should be applied prior to laying the new macadam surface.

If the condition of the porous concrete surface is rather less good, with some displacement of the bays and/or major cracking having taken place over the years, it may be prudent to superimpose an intermediate 25-50mm thick layer of graded stone chippings on the concrete surface before laying the macadam. These chippings must be carefully screeded to level and rolled.

If there is general evidence that the concrete surface has moved significantly and may be continuing to do so, the concrete surface should be broken up completely, the resulting material being re-levelled and compacted to form a new foundation for the macadam. There are various ways of breaking up the concrete - a mini road planer is very effective.

4.8.2 Resurfacing Porous Concrete with Artificial Grass

Unless the porous concrete is in exceptionally good condition, it will be necessary to apply a macadam layer (see above) prior to laying the sand-filled artificial grass.

If, however, the porous concrete surface is in good condition with little or no movement at the joints, it may be possible to lay the sand-filled artificial grass directly on to it. Some preparatory work is invariably necessary and must be meticulously executed if features of the existing surface are not to show through the sand-filled artificial grass very clearly.

If it is decided to drill the porous concrete to re-establish free drainage the back-filling of the holes with chippings must finish perfectly flush with the existing surface. The chippings should be bound with bitumen emulsion to prevent them being dislodged by the carpet laying process.

All the joints, too, should be filled and finished flush by trowelling. Sand and cement, or a latex-based screeding compound is suitable for this purpose. Any small holes or worn areas should be treated similarly.

4.8.3 Resurfacing Porous Concrete with an Acrylic Surface

It is rare to find a porous concrete court which has been laid to the gradients required for an impervious acrylic surface e.g. 1:120 to 1:100. It is best therefore to break up the porous concrete and to regrade the resulting material to form the new foundation. A mini road planer will break the porous concrete material into small enough pieces to allow this to be done.

4.8.4 Edgings

Porous concrete courts will not have edgings, and new ones must invariably be provided when resurfacing with alternative surfaces.

4.9 Resurfacing Grey-Green Courts

There are thousands of grey-green courts still in regular use in the U.K., most of them in private gardens. Many are of considerable age and will have been resurfaced on several occasions already. Replacing a worn-out grey-green surface is usually a straightforward, low-cost procedure but the surface is now declining in popularity, and giving way to more modern surfaces such as porous macadam or sand-filled artificial grass. Central to deciding the appropriate specification for changing a grey-green surface, is an assessment of the suitability of the existing foundations. The grey-green surface is remarkably flexible and requires no heavy machines in its construction. The result is that the existing foundations frequently require upgrading before they are suitable for the new surface. This is especially so if the existing foundation consists of ash or clinker, which will often be the case.

4.9.1 Resurfacing Grey-Green with Grey-Green (Renovation)

If the existing grey-green surface is in very poor condition, (for example infested with weeds or breaking up over a significant proportion of its total surface area), it may be wise to break-up the surface completely, either by hand or with a heavy-duty garden rotovator, removing deep-rooted weeds in the process. (An application of weedkiller should already have killed the weeds - see section 4.2.6).

The broken-up surface should then be raked to level, rolled and a layer of 10mm or 14mm clean stone chippings screeded on to provide a level sub-base. The chippings should be rolled and tack-coated with bitumen emulsion to receive the new grey-green surface.

If the existing grey-green is in rather better condition but has localised depressions or broken-up areas, a much lesser quantity of dry 10mm chippings may be sufficient to strengthen or level up the affected areas. Alternatively, chippings pre-mixed with bitumen emulsion may be used. Following rolling and providing the remainder of the surface is free-draining, a bitumen tack-coat is then applied to receive the new grey-green surface.

Impervious or slow-draining areas should be pierced with large holes at 500mm centres (e.g. by using a road-drill or similar) the resulting holes being back-filled with chippings.

If the existing grey-green court is in reasonably good condition but has lost its level, a layer of dry 14mm or 10mm chippings, of sufficient thickness to correct the levels, should be raked or screeded on, rolled and tack-coated with bitumen emulsion to receive the new grey-green surface. Again, the existing surface should be pierced at 500mm centres and the resulting holes back-filled with chippings if it is not free draining.

If the existing grey-green surface is stable and is of good level, it may only be necessary to pierce the surface at 500mm centres, back-fill the holes with chippings, roll and apply a tack-coat of bitumen emulsion to receive the new grey-green surface. In this instance, rather more care should be taken in back-filling the drill-holes with dry chippings to ensure that they finish flush with the surface and are fully consolidated. Failure to take this extra care may result in the drill-holes sinking and reflecting through the new grey-green surface.

If the existing grey-green surface is very free-draining it may seem unnecessary to pierce it. It should be remembered, however, that the bitumen tack-coat will reduce the porosity of the old surface and any water lying upon it could have serious consequences if it becomes frozen in winter.

Whilst it is not intended to go into the details of the various proprietary methods of laying a grey-green surface, it may be possible or even wise to dispense with the bitumen tack-coat if the grouting method of surface construction is to be used. This reduces the possibility of seriously impairing the drainage as a result of an excess of bitumen emulsion collecting on the old surface.

4.9.2 Spray and Grit

Thus far, it has been assumed that a complete new grey-green surface is to be provided. Where the existing grey-green surface is beginning to fret or break-up, it is sometimes recommended that a "spray and grit" will extend the life of the surface for a few years. This involves sweeping off any loose surface grit or chippings, applying a bitumen emulsion tack-coat (by spraying) and providing new surface grit. This procedure can indeed prove effective but should only be attempted where the existing surface is free-draining because a "spray and grit" inevitably reduces surface porosity.

4.9.3 Resurfacing Grey-Green with Macadam

Laying a macadam surface necessitates the use of a significantly heavier roller than would have been used on the grey-green surface. This usually means that only grey-green courts constructed in recent years that have an adequate crushed stone foundation are likely to

provide a suitable sub-structure for a macadam surface. It may also be possible that a grey-green court that has been resurfaced a number of times over the years may have sufficient strength to perform satisfactorily as a sub-base for macadam.

If the conditions outlined above are met, then it may only be necessary to pierce the existing surface at 450mm intervals, carefully back-fill the resulting holes with dry-chippings ensuring that they are consolidated and flush, roll the whole court and apply a bitumen emulsion tack-coat to receive the macadam surface.

If the existing grey-green court has less-strong or less-stable foundations, or is otherwise inadequate, it will be necessary to superimpose a new crushed stone foundation the thickness of which could be as little as 50mm where the inadequacy is marginal, to a full 100-150mm compacted thickness in the worst cases. The presence of a foundation of frost-susceptible ash or clinker under the grey-green surface would indicate these greater thicknesses, not only to compensate for the lack of strength of the ash, but also to insulate it from frost. In all such cases, it is essential to roll the whole court thoroughly before resurfacing with a roller at least as heavy as that used to consolidate the new macadam surface (see section 4.3.1.1).

4.9.4 Resurfacing Grey-Green with Artificial Grass

If the existing grey-green surface is level, stable and free-draining it should be possible to lay a sand-filled artificial grass surface directly upon it, having first removed all loose surface grit. To improve further the drainage the grey-green surface can be pierced at 450mm centres over its entire area, or in areas where drainage may be slower, such as around the baselines. It is particularly important, however, to ensure that the drill holes are carefully back-filled and finish flush with the surface.

It is also a wise precaution to bind the chippings in the drill holes with bitumen emulsion to prevent them becoming dislodged during the carpet-laying process. Unless the grey-green surface is in first-class condition, it is usual to superimpose a porous macadam layer before laying the sand-filled artificial grass (see above).

4.9.5 Resurfacing Grey-Green with Acrylic

It is very unlikely that an existing grey-green court would have adequate foundations, the appropriate cross-fall and be in sufficiently good condition to receive an impervious acrylic surface. At the very least, it would be necessary to superimpose a dense bitumen macadam surfacing course. It is far more likely that a major reconstruction would be necessary during the course of which the existing court would provide little more than a level site.