SPORTS&PLAY
INDUSTRY ASSOCIATION LIMITED

SAPIA CODE OF PRACTICE

FOR THE CONSTRUCTION, SURFACING AND MAINTENANCE OF SPORTS COURTS

TENNIS • NETBALL • BASKETBALL MULTISPORT COURTS

www.sapia.org.au

(July 2022, 1st Edition)

Adapted for Australia from the SAPCA Code of Practice for
the Construction and Maintenance of Tennis Courts
www.sapca.org.uk

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Acknowledgements

SAPIA would like to acknowledge the assistance received from those who contributed towards the production of this Code of Practice: in particular, our UK sister association SAPCA for allowing us to adapt their Code of Practice for Tennis Courts, and, in Australia, the following representatives of SAPIA members (in alphabetical order):

Acousto-Scan	Grant Humphreys
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Smartlux	Craig Nicholls
Surfacing Contractors Australia	Mark Weber
Synthetic Grass & Rubber Surfaces Australia	Mark Cunningham
Sports & Play Industry Association	Robyn Wilcox

Our intention in producing this document is to provide prospective clients and specifiers with guidance on the basic construction requirements and specifications currently employed in building sports courts. The standards outlined throughout the document have been recognised and supported as the minimum level for the construction of sports courts in Australia. 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.

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

As the recognised Australian trade association, SAPIA fosters excellence, professionalism and continuous improvement throughout the sports, recreation and playground construction industry, in order to provide the high quality facilities necessary for the success of Australian sport.

Customers and decision makers can partner with SAPIA in upholding the highest quality standards by ensuring that the contractors with whom they engage are SAPIA Members. A directory of current members is available on the SAPIA website www.sapia.org.au

SAPIA'S AIMS AND OBJECTIVES

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

The SAPIA website provides a wealth of valuable information for anyone involved in the development of sports and play facilities. Visit www.sapia.org.au for Technical Guidance, Exhibitions & Events, the SAPIA Membership Database and more. Visitors are invited to subscribe to the free SAPIA News Update service to receive regular news bulletins.

FURTHER INFORMATION

The Sports and Play Industry Association operates through its own full-time administration. For further information, including a list of members, or to enquire about membership, please contact SAPIA at the address below.

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TABLE OF CONTENTS

GLOSSARY OF TERMS

The glossary below is common to tennis, netball, basketball and multi-sports courts:

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)	To within 1m of the court perimeter. For certain parameters (e.g. floodlighting) the TPA may be reduced in size from the total area to specified dimensions beyond the court markings. Court area plus run-off area.
PRINCIPAL PLAYING AREA (PPA)	Area bounded by perimeter line-marking of individual sport being played.
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 laid side by side.
GRADE	The prepared natural ground on which the court is built.
SUB-GRADE	The foundation of the court, normally formed from graded aggregates.
CONCRETE	A composite material composed of fine and course aggregate bonded together with cement. Usually the slab is a minimum 100mm laid over a blinding layer of sand, reinforced with steel.
ASPHALT BINDER COURSE	A layer of coarse asphalt that is laid on the base to provide stability and strength to the finer grade asphalt laid on top of it; formerly known as the base course.
ASPHALT SURFACE COURSE	A layer of 7mm or 10mm aggregate (stone size) asphalt laid either as the playing surface or as the receiving layer for a synthetic surface. Asphalt course thickness to be determined by engineer's specifications.
ARTIFICIAL GRASS / SYNTHETIC TURF	A piled carpet, normally of tufted 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.
CLAY	A range of unbound mineral surfaces that traditionally have a slow court pace and allow players to slide. Within this general group is French clay (as used at the French Open), European clay, American Fast-Dry and shale.
SYNTHETIC CLAY	Surfaces designed to replicate the playing qualities of clay surfaces, but not suffer from the climatic limitations often associated with clay surfaces.
POLYMERICS	Sheet or in situ surfaces formed from rubber bound together with a binder (normally polyurethane).

NOTES TO BE READ IN CONJUNCTION WITH THIS CODE OF PRACTICE

This Code of Practice is intended for use by sports court contractors, sports facility design professionals and sports 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 sports courts constructed under normal climatic conditions in Australia, the Sports and Play Industry 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 Industry Association are committed to meeting. As guideline specifications, however, they do not supersede a reasonable interpretation of the specification and terms of contract applied in each contract. For individual projects, variations in climate, soil conditions, topography and other site-specific conditions may necessitate standards of specification greater than those recommended within the Code of Practice.

Parties not experienced in sports court construction are strongly advised to consult qualified contractors and/or court construction consultants. Details of experienced sports court contractors and consultants can be provided by the Sports and Play Industry Association.

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

In accordance with common practice within the construction industry, the depth of any individual construction layer is specified within the Code of Practice as the nominal compacted depth. The nominal depth can be regarded as the design depth of a layer of construction within a sports court, within the applicable tolerances margins.

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

The information contained within the Code of Practice, while accurate at the time of publication, may be subject to change at a future date. Due to changing 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 be used.

A 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 President, Sports And Play Industry Association, PO Box 118, Mona Vale NSW 1660 Australia’. Revision to the Code of Practice will be made when such action is considered appropriate.

INTRODUCTION

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

- **SECTION ONE** of this Code of Practice 'General Information & Surface Selection' covers performance requirements of sports surfaces and the types of testing: court 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.
- **SECTION TWO** guides the reader through a detailed account of the Construction guidelines for each surface. It covers such detail as drainage issues, dimensions, orientation and weather considerations when constructing the courts. The general requirements of the playing surfaces are also detailed: evenness, porosity, surface texture, joints, initial settling down period and finally corrective action, if needed. The chart 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** of this Code of Practice is a Maintenance guide for each different court surface. 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** on 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.
- **APPENDIX A** Table Summarising Sports Field Lighting Illumination Requirements

CONSTRUCTION OF A SPORTS COURT	
1. Project Brief	This phase reviews the project brief and considers factors such as: location, usage, funding, procurement and project management.
2. Project Feasibility	This phase can include the development of a business plan, planning application and funding application. A consultant can be appointed during this phase, although this will normally be required only for a larger project.
3. Site Investigation	Prior to the design phase, a detailed site investigation may be required. This includes topographical, geotechnical, electrical and drainage surveys. This may not be necessary on a small project.
4. Design Specification	This phase includes the production of full design specifications and technical drawings.
5. Tender Process	In this phase, a review of submissions is undertaken. This includes evaluation and contractor selection.
6. Construction Period	This phase includes the construction of the facility. If required, independent quality control is undertaken to assess build quality and design specification conformity.
7. Project Completion	This section includes the hand-over of the completed project. If required, performance testing should be undertaken to ensure compliance. Additionally, a maintenance regimen should be provided by the installer.
8. Aftercare	This phase includes the ongoing maintenance programme and warranty period of the installation.

SECTION ONE

GENERAL INFORMATION

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SURFACE SELECTION

Section One: General Information & Surface Selection

1.1 TYPES OF PLAYING SURFACES

1.1.1 Sand-Filled Artificial Grass Surfaces

Sand-Filled Artificial Grass (SFAG) sports courts have been used for many years. Correctly maintained, they have gained acceptance and are one of the most popular forms of court surfacing for club and recreational sports.

Domestic synthetic grass tennis court

1.1.1.1 Tufted carpets

The clear majority of SFAG courts are tufted carpets which 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 can be added by punching holes through the backing. The pile of 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 an approved stabilised base. There are varying heights and densities for different sports - refer to individual manufacturer's specifications.

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. While 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. 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 can influence the court pace, although carpets with a low number of tufts per square metre are considered by some to be slow when new.

Some products also use a textured 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 court pace rating to medium pile carpets (medium fast to fast).

Examples of synthetic grass with differing pile heights, suitable for sand-filled tennis and multisport courts

The use of various particle sizes and quantity of infill or alternative surface dressings (e.g. rubber crumb) will also allow manufacturers to adjust the playing characteristics of a surface.

Inlaid lines are made up of a section of the parent roll of carpet that is cut out and a line inserted. The line is manufactured 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 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 manufacturing. As carpet rolls are normally laid along the length of a court, this makes it quite simple to incorporate e.g. the singles and doubles side markings for tennis. By laying rolls of carpet across the back of each court (at 90º 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., these are normally inlaid.

Installing a domestic synthetic grass tennis court

A common practice when installing synthetic grass surfaces is to apply glue directly onto the concrete slab. An alternative method is to lay the carpet fixed onto tapes with adhesive on top, which allows storm water to drain away beneath the carpet and on top of it.

Synthetic grass is available in a range of colours

Inner city rooftop synthetic grass tennis courts

1.1.2 Acrylic Surfaces

Acrylic is a term which describes a surface in common use throughout the sports-playing world. Traditionally formed by multiple applications of coloured acrylic or resin materials laid on an impervious asphalt or concrete base, the surface's playing characteristics make it suitable for all standards of play, up to the highest levels of competition (e.g. US and Australian Tennis Opens). The surface encourages and rewards good playing technique and so is also ideally suited for all levels of coaching and training.

Acrylic surfaced netball complex

An acrylic surface can be played on all year round, 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, the water must be cleared. This 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 pre-formed shockpads. While 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 sports shoes. Tight tolerances for surface levels and high standards of specification and workmanship are essential for the successful installation of these surfaces. Foundations must be strong, carefully compacted and protected from water ingress to prevent settlement, movement or frost damage.

Acrylic surfaced multisport complex

Acrylic surfaced netball complex

Acrylic surfaced multisport complex

Acrylic surfaced netball courts

1.1.3 Polymeric Surfaces

A polymeric sports 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 cushioning, providing a softer and more comfortable footing than the harder surfaces such as asphalt.

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. The base for a polymeric court is a conventionally engineered asphalt or concrete court.

Figure 13 – Polymeric surfaced sports court

Polymeric surfaced sports court

1.1.4 Clay surfaces (tennis only)

1.1.4.1 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, Italian Clay as used at the Italian Open and American clay.

Traditional clay tennis court (*photo: Gonzalo Facello*)

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 require 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.

1.1.4.2 Synthetic and hybrid clay surfaces

Several surfaces are designed to have the playing qualities of clay (see above) 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 using a variety of material – including coated infills and/or rubber granules. Hybrid clay courts have a traditional clay topping.

Synthetic clay tennis court

1.2 PERFORMANCE TESTING OF COURT PLAYING SURFACES

There are several test methods and standards that may or may not apply to all or a specific type of surface. For a client to choose the right type of surface for a sports facility it will be necessary for them to make informed choices. Having surfaces and facilities tested is a method by which specific performance information may be passed from contractor/supplier to a client to aid in making those choices. Facility testing can also be used as a method to ensure predicted quality of any sports surface.

1.2.1 International Tennis Federation (ITF) Court Recognition (Tennis)

The ITF administers a court recognition scheme. There are two categories: One Star and Two Star (1* and 2*). The tests involved with each classification are detailed below:

One Star

One Star Category	Test method
Evenness	ITF CS 02/02
Slope and Planarity	ITF CS 03/03
Dimensions	ITF CS 04/02

Two Star

Two Star Category	Test method
Court pace rating	ITF CS 01/02
Evenness	ITF CS 02/02
Slope and planarity	ITF CS 03/03
Dimensions	ITF CS 04/02

One Star ITF Recognition is achievable for any court, whereas Two Star ITF Recognition is only available to a court with a surface that is already classified under the ITF Court Pace Classification programme. Contractors, suppliers of surfaces, specifiers and owners of facilities should be aware that in order to obtain ITF court recognition a full application process is required, for which the ITF charge a fee. In addition, there are also costs associated with having the testing done, which may only be carried out by an ITF-accredited laboratory. The recognition certificates are valid for three years.

1.2.2 BS EN 15330 testing of artificial grass tennis courts

BS EN 15330 is a European Standard which gives performance and durability requirements for artificial grass sports surfaces. It contains a section regarding both materials and field testing of artificial grass tennis surfaces and courts. The Standard describes the following test methods:

Materials test	Test method	Field test	Test method
Tensile properties of synthetic turf carpet	EN ISO 13934-1	Angled ball behaviour	EN 13865
Tensile strength of carpet yarn	EN 13864	Vertical ball rebound	EN 12235
Resistance to artificial weathering	EN 14836	Shock absorption	EN 14808
Synthetic turf joint strength	EN 12228 Part 2 or Part 1	Rotational resistance	EN 15301-1
Synthetic turf joint strength before and after wager ageing	Water ageing to EN 13744	Water permeability	EN 12616
Synthetic turf tuft bind	ISO 4919	Surface regularity	EN 13036-7
Water permeability	EN 12616	Product verification testing	As described in Table 3 in EN 15330
Tensile strength of shock pads	EN 12230 + air ageing to EN13817		
Abrasion resistance of non-fill short pile synthetic turf	EN 13672		
Vertical ball rebound	EN 12235		
Angled ball behaviour	EN 13865		
Shock absorption	EN 14808		
Rotational resistance	EN 15301-1		

BS EN 15330 Tests

1.2.3 Court pace

This test is described in ITF test procedure CS/01/01 and BS EN 13865, although there are small differences between the methods and the results should not be considered the same. 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 due to the impact with the court surface, and adding in factors relating to the co-efficient of friction and co-efficient of restitution, a value known as the Court Pace Rating is derived; the higher the number, the faster the surface. The ITF has established a classification for court paces, which has five bands.

Court pace range	Classification
≤ 29	Slow
30-34	Medium slow
35-39	Medium
40-44	Medium fast
≥ 45	Fast

ITF classifications for court paces

For certain surface types, the court pace is a function of the surface, and there is little a manufacturer can do to influence it – e.g. porous asphalt has 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 court 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, while on other surface types it increases as courts wear.

1.2.4 Slip resistance

The slip resistance of asphalt, polymeric and acrylic courts can be measured using a skid resistance pendulum mounted with a rubber test foot. The test procedure is described in BS EN 13036 Part 4 using the CEN (soft) rubber test foot.

1.2.5 Shock absorption

The shock absorption of many forms of sports surfaces is measured using the test procedure described in European Standard BS EN 14808. 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).

1.2.6 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.

1.2.7 Slope and planarity

A sports court should be built in a single plane. Where a gradient is required, a cross slope is preferred, but an end to end or a diagonal fall is permissible provided the single plane is maintained and the gradient does not exceed 1:120 = 0.83% (recommended maximum) or 1:100 = 1% for impervious constructions (acrylic). There is a method for measuring slope and planarity described in ITF test procedure CS/03/03. This test procedure is also applicable to other sports.

1.2.8 Surface evenness

Ideally, a sports court surface should be flat. It is recognised, however, that construction of a court requires tolerances to be applied which relate to the practical constraints of installing a large surface. The tolerances for each surface type are given in Section 2.14.1 of this Code. The method for measuring surface evenness is described in ITF test procedure CS/02/02.

1.2.9 Dimensions (Tennis)

The correct positioning of the play lines and net are defined by the Rules of Tennis and provide consistency between courts. The key dimensions, the tolerances that may be applied and a method for measuring and checking these dimensions are described in ITF test procedure CS/04/02. As a guide, the tolerance on all dimensions in excess of 5 metres is 0.1% and for all dimensions of 5 metres and below the tolerance is 5mm.

For example, the distance between base lines should be 23.774 metres, so the tolerance on this dimension is 23.774 millimetres, which is rounded to 24mm. For the distance from the outside of the singles to the outside of the doubles, tram lines should be 1.372 metres – a dimension less than 5 metres – and so the tolerance is 5mm.

1.2.10 Dimensions (Other Sports)

The Government of Western Australia's Department of Sport & Recreation publishes a Sports Dimensions Guide online. This is a good resource and includes dimensions of many sports played in Australia. The following link is current at the time of publication:
https://www.dlgsc.wa.gov.au/sport-and-recreation/sports-dimensions-guide

1.3 PROFESSIONAL EXPERTISE

While a sports court may appear to only be a simple construction with a synthetic or painted surface, the exacting demands and tolerances of the sport mean that they are best built by companies with the relevant and proven construction expertise. Specialist expertise is essential when undertaking the design, specification and project/construction management of a sports court development. Checks should be made on the experience of the contractor and designers being considered for selection. SAPIA ensures that its sports court construction members have the necessary experience and proven quality of workmanship to undertake this niche field of construction work. For a list of current SAPIA members, refer to the SAPIA Member Directory which may be found on our website www.sapia.org.au

SECTION TWO

CONSTRUCTION GUIDELINES

2 Section Two – Construction Guidelines

2.1 SITE CONSIDERATIONS

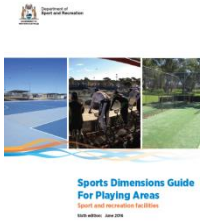
Selecting the correct site for a court is a major factor in determining not only the costs of construction, but also the quality of the playing experience and the maintenance needs of the court.

Where possible, the location of a sports 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. Access should be easy for players (including disabled players) and suitable for maintenance and construction equipment (all courts will require resurfacing at some point; a factor often overlooked).

As new court developments may 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.

Compliance with the Disability Discrimination Act is an obligation for clubs, schools and other organisations. 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



The Government of Western Australia's Department of Sport & Recreation publishes a Sports Dimensions Guide online. This is a good resource and includes dimensions of many sports played in Australia. The following link is current at the time of publication:
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2.3 ORIENTATION

It is generally recommended that sports courts be orientated approximately in a north-south direction. This orientation is preferred (although not essential) because it minimises the effect of the setting sun on the eyes of the players.

2.4 GROUND CONDITIONS

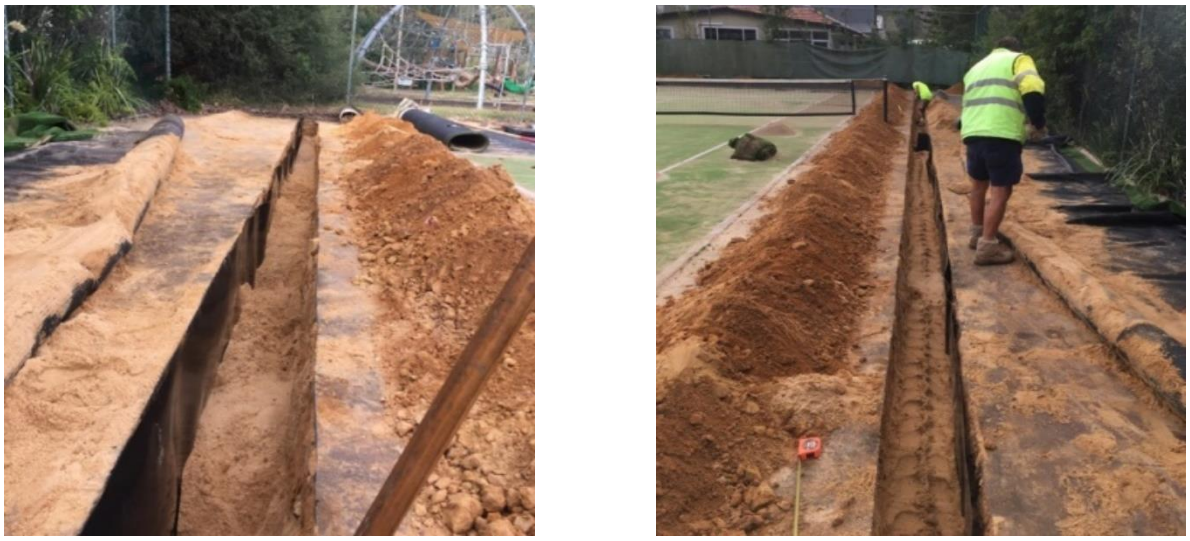
The cost of a court is greatly influenced by site conditions. Costs will be much higher for engineering a difficult site, and it should be recognised that some sites are not cost effective to develop. A designer should consider several factors, including topography, access, site drainage, trees and ground 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. While 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 the best way of ensuring a full understanding of the site.

2.5 TREES

Trees may provide 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.

Where such a threat exists, preventative action will be necessary, such as tree surgery and/or the construction of a root barrier to inhibit the ingress of tree roots onto the sports 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 according to site conditions. The wall of the trench is then lined with suitable material, such as root control sheeting or concrete, before backfilling.



Installation of root barrier

Branches that overhang a court are usually a cause of various problems, such as the continuous dripping of water, secretions and bird or bat 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 to the court fence line.

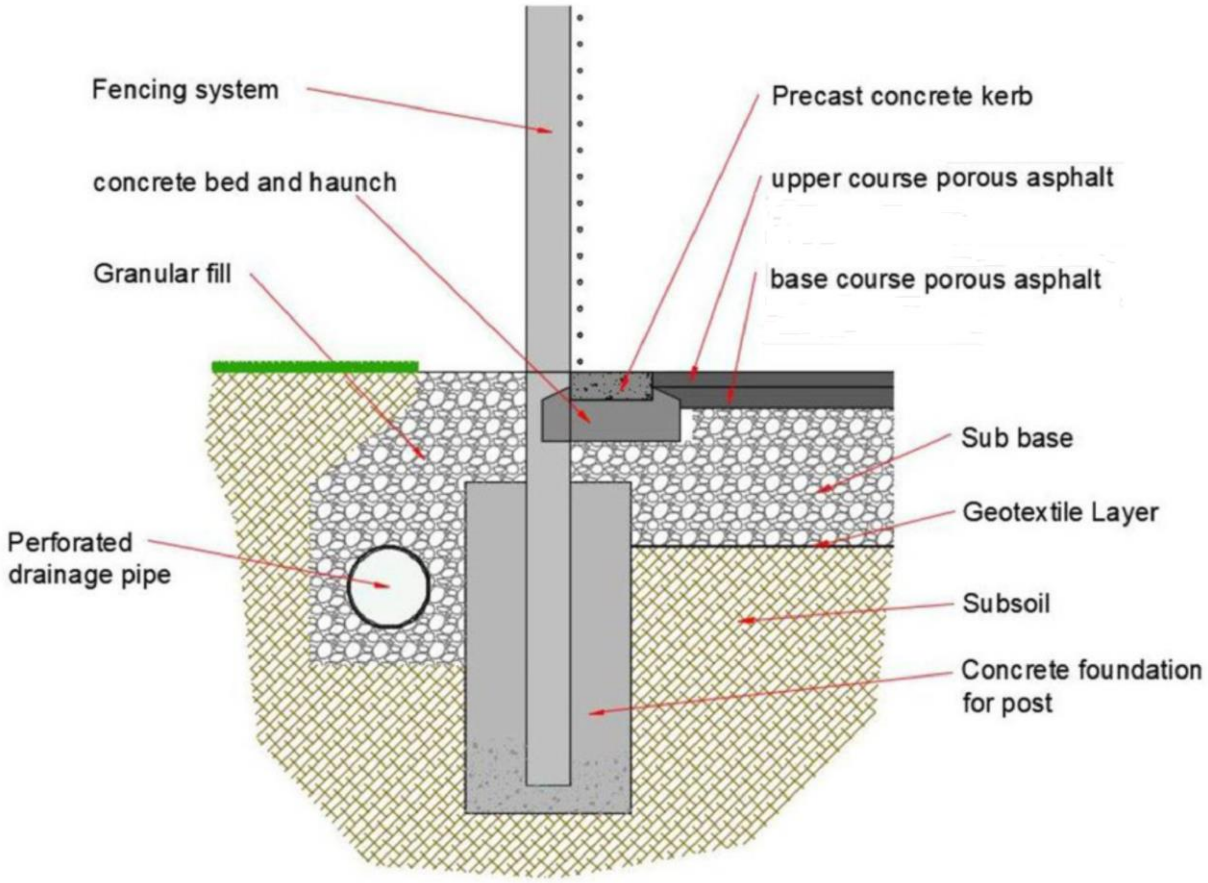
2.6 SERVICES

When selecting the site for a court, consideration should be given to the services that may be required. Many sites will require some form of drainage. Electricity and/or water supplies may also be required.

Liaison with Dial Before You Dig www.1100.com.au is highly recommended for location of existing services, and for insurance purposes it may be necessary.

2.7 CONSTRUCTION GUIDELINES

Most forms of sports court, other than traditional 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 the diagram below, which is a typical cross section of a court construction:



Typical cross-section of a sports court: SAPCA

Principal elements of the above diagram comprise:

- the sub-grade: this is the prepared natural ground on which the court is built
- the sub-base: carefully graded aggregates which 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
- asphalt base: bitumen bound aggregate that forms the base on which the playing surface is laid or in the case of asphalt courts forms the playing surface
- concrete base: cement bound aggregate that forms the base on which the playing surface is laid and is in lieu of the asphalt base (and is subject to ground conditions). In some cases when properly specified, may replace the sub-grade

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.

Excavating a new site

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 using 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 compacted 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.

Care should be taken to ensure that the completed grade and sub-grade achieve the recommended compaction and moisture content.

Excavation of a bank

Retaining wall installed to support bank

2.9 WEED KILLING

Residual acting weed killers are no longer acceptable on environmental grounds. Weeds visible prior to excavation works should be pre-treated with a systemic weed killer. It is not possible to guarantee either to kill all weeds, or that no re-growth will occur after construction. Some weed growth may occur, but this usually represents little more than a temporary inconvenience. Wind-blown seeds can land on any sports court where they may wash into the porous construction and germinate. 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 and requirements of the sport – 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 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.

2.10.2 Sub-court drainage

Sub-court drainage may be required, subject to engineer's advice. Perimeter drains located just outside the perimeter edging are necessary on poorly draining sites.

Examples of catchment drains

Excavation for drainage

Catchment 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 catchment drainage systems may be appropriate for intercepting water running off impervious surfaces.

Drains should consist of 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 specified falls and be connected to the lowest point of discharge well clear of the court area.

Catchment 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. While 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 catchment drain be installed along the lower side(s) of the court.

Catchment drain in corner of impervious court

2.11 BASE FOUNDATIONS

A well-engineered foundation is just as essential to the performance and durability of a sports 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 during the varying seasons and climatic conditions. 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.

Frost heave is caused when frost penetrates susceptible sub-soils that include a lot of fine, silt-like material. The 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.

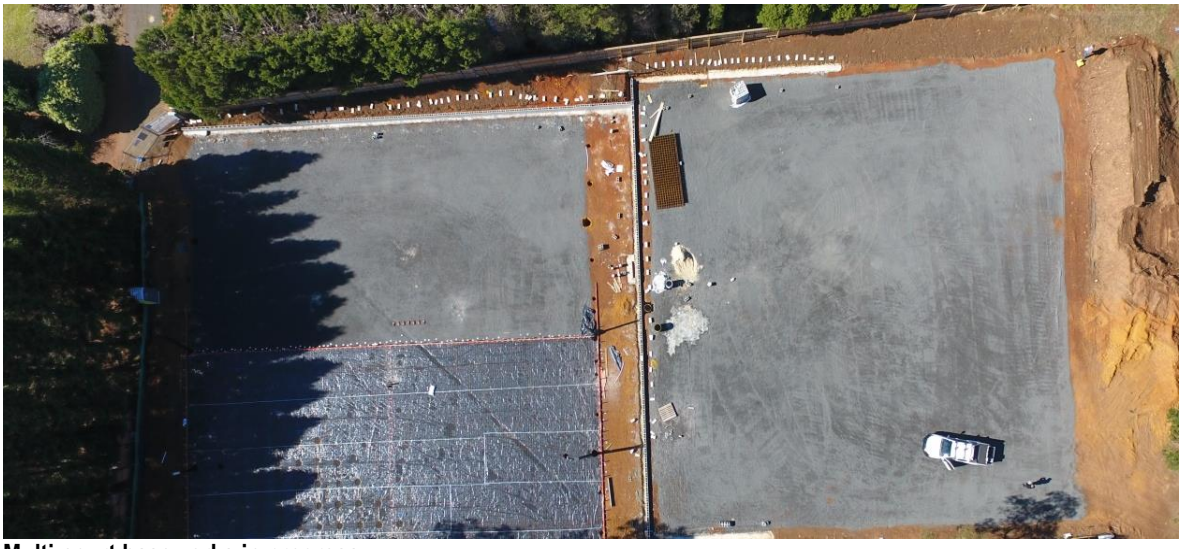
Many clay soils are prone to swelling when hydrated, and shrinking and cracking when dehydrated. This will often show as cracking in a lawn during a dry summer. Such cracking and settlement or swelling will transmit through to the surface if an insufficient depth of foundation is provided.

Foundations should be constructed using hard, clean, well-bound aggregates. 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;
- Thicker foundations provide greater load-bearing capacity and may allow the use of heavier machinery (e.g. laser-controlled graders), giving more economic and higher quality surfacing with better surface tolerances.

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 way of guaranteeing no heave at all on moisture-susceptible sub-soils.

Determining the right balance between achieving value for money and minimising (if not eliminating) any risk, is not easy. Also, to a large extent it depends on the perception and budget of the client.



Multi-court baseworks in progress

The following table should be used as a guide and may be adjusted to consider specific site information, weather conditions at time of construction and local knowledge. If in doubt, it is recommended that specialist expertise be sought.

Soil Type	Typical CBR %	Potential Frost Action	Potential Shrinkage Swelling	Foundation depth mm	Total construction depth mm
Slightly silty/clayey sand or gravel	20-60	minimal	minimal	150	150
Silty/clayey gravel	20-60	slight	minimal	150	215
Silty/clayey sand	15-40	medium	minimal	150 – 200	215 - 265
Very silty/clayey gravel	10-20	slight-medium	minimal	150 – 200	215 – 265
Very silty/clayey sand	5-15	minimal	minimal-medium	150-250	215-315
Sandy/gravelly silt or clay	5-10	medium-high	slight-medium	250-335	315-400
Silt	5-10	medium-very high	slight-medium	300 - 385	365 – 450
Clay	1-5	medium-high	medium-high	300 – 385	365 – 450

Design depths of foundation level for each soil type

The figures given in the table show the design depths for any site or soil type. From a construction point of view, however, a tolerance is required on these figures to reflect the practicalities of working on site. It is recommended that at no point on a 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 area 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 inclement weather. These materials are normally found to be of a medium to high risk and are treated as a sandy/gravely silt or clay material in accordance with the above table.

When designing the area for court foundations, it is best practice to ensure that the area of foundation material extends at least 600mm outside of the court surface/kerbing – especially in fill areas where cut and fill techniques have been employed – to ensure that kerbing and fencing do not in time move/subside off the foundation area.

2.11.1 Geotextiles

Geotextiles are water-permeable fabrics that are laid in sheet form beneath the foundation to provide several 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 inhibiting possible weed growth from the sub-soil zone to the surface
- inhibiting possible weed growth from the sub-soil zone

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

2.12 FLOODLIGHTING CONDUITS

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

Conduits normally take the form of either a minimal, partial or full system, depending on the layout of the courts and surrounding structures. Once the appropriate layout has been selected a conduit and draw-pit design may be developed.

Conduits are normally formed from PVC piping, the depth determined by local regulations, and conduits are of a size depending on the design.

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 asphalt base. 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 on the playing surface.

2.13 BASE CONSTRUCTION

2.13.1 Asphalt Base

Asphalt being laid

2.13.1.1 General

Following are the general material supply requirements for the construction of a hot-mix asphalt base. This base can be used under synthetic acrylic or synthetic grass. It can also act as a final playing surface.

2.13.1.2 Preparation of Subgrade

The subgrade will be prepared in accordance with the specification subgrade and will be fully proof rolled prior to any further works.

2.13.1.3 Installation of Concrete Border

A concrete kerb/border is to be installed along the high side of the courts(s). This kerb is to be installed to design line and level +/- 5mm, with the top of the kerb flush with finished surface level. Concrete is to be a minimum width of 150mm and 150mm deep using 20MPa 20mm concrete.

A concrete spoon drain is to be installed along the lower sides of the court(s). This drain will be laid true to line and level +/- 5mm with the top of the drain flush with finished surface level. The spoon drain is to be a minimum width of 450mm and 25mm deep. The spoon drain is to empty into corner sump pit of dimensions 200 x 200mm. This pit is to discharge to local storm water pipes.

2.13.1.4 Installation of Crushed Rock

The crushed rock base is to be built to achieve an even grade to design line and level +/- 8mm and compacted to reach 95% standard. The crushed rock is to be placed and compacted at optimum moisture content. It is advisable that the rock be delivered plant mixed at this moisture level. The method for achieving design tolerance shall be by use of motorised grader. Compaction shall be by use of mechanical roller with a minimum static weight of 3.0 tonnes.

When crushed rock placement is completed, the finish should be dense and uniform, and basically impervious with no area holding water greater than 5mm. The crushed rock used should conform to the following grading:

Sieve Size (Aggregate size mm)	Limits of Grading (% Passing)
26.5	100
19.0	95-100
13.2	78-92
9.5	63-83
4.75	44-64
2.36	30-48
0.425	14-22
0.075	6-10

This rock is to have a max PI of 8 and a min CBR of 25. All rock covered under this specification is to be supplied in accordance with Vic Roads Standard Specification (Section 407).

2.13.1.5 Prime

Hot cutback bitumen shall be sprayed if specified at a minimum rate of 0.8 Litre/m2. Where possible, this bitumen shall be applied by means of a calibrated road sprayer. Where access

does not allow for this method, a hand lance may be used, but extreme care must be taken to avoid ponding of bitumen. Where ponding does occur, this area shall have a thin layer of sand or dust applied to soak up excessive bitumen. Care should be taken to protect all concrete and adjoining surfaces from overspray.

2.13.1.6 Hot Mix Asphalt

Asphalt shall be delivered hot to site and placed in paver with minimum delay. The paver shall be self-propelled, equipped with hoppers, distribution screws of the counter rotation type to place asphalt evenly in front of its heated screed.

The asphalt shall be rolled while hot to achieve design thickness (minimum 30mm) with a self-propelled roller capable of reversing without backlash.

When completed, the total area shall be checked to ensure a tolerance of +/- 5mm under a 3.0m straight edge on any two points on the court is achieved with no machine or tool marks. Where such blemishes are found, the area shall be heated and rerolled or tamped with mechanical compactor. Surface tolerances should be checked within 30 days of the pavement installation and prior to the installation of any surfacing onto the pavement.

The entire area is to have size 7mm type L hot mix asphalt machine-laid to design grade. The aggregate grading will conform to the following:

Sieve Size (Aggregate size mm)	Limits of Grading (% Passing)
9.5	100
6.70	80-100
4.75	70-90
2.36	45-65
1.18	34-55
0.600	22-45
0.300	14-33
0.150	8-18
0.075	5-8
Total mineral matter	100

Bitumen content is to be between 5 - 7.5%.

2.13.2 Concrete Base

2.13.2.1 Preparation of Sub Base

A layer of crushed rock or packing sand shall be used to present a uniform sub base to line and level within a tolerance of +/- 10mm. It is recommended that a laser controlled grader or land plane is used to achieve this tolerance.

2.13.2.2 Polythene

Black or Orange grade Polythene of 200 micron thickness shall be used under all acrylic slabs. This shall be held in place with 50mm plastic adhesive tape.

2.13.2.3 Installation of Reinforcement

The reinforcing fabric shall be overlapped to minimum of one square in each direction and securely tied at 1.5m centres. Where possible, consecutive rows of fabric should be "offset" to avoid clusters of welded mesh. A minimum F52 (or F62 Synthetic Acrylic) welded reinforcing mesh shall be used. All mesh should be clean and free of oil, mud or rust and placed accurately in the concrete to ensure a minimum cover of 30mm.

Installation of reinforcement

2.13.2.4 Installation of Concrete

All concrete shall be pumped into place by means of a "Squeeze" type pump. Sufficient labour shall be on hand to roughly place the concrete to desired line and level. A minimum of two "screed hands" shall be on the site to quickly screed an accurate finish to the slab and avoid overworking and segregation of concrete. The final tolerance on the finished surface shall be +/- 4mm such that no point on the court shall vary greater than 4mm under a 3.0m straight edge when placed on any two points on the court. Surface tolerances should be checked within 30 days of the pavement installation and prior to the installation of any surfacing onto the pavement.

Installation of concrete

It is imperative to arrange for a constant supply of concrete to avoid cold joints in slab. No additives are to be placed in concrete mix when synthetic acrylic surfacing is intended to be used.

The concrete is to have a dense steel trowelled finish when synthetic grass is used and wood float or broom finish is preferred for synthetic acrylic, concrete to be:

(a) N20 grade (min);
(b) 80mm slump (max); and
(c) 20mm max size aggregate.

Figure 32 – Installation of alternate concrete slab design

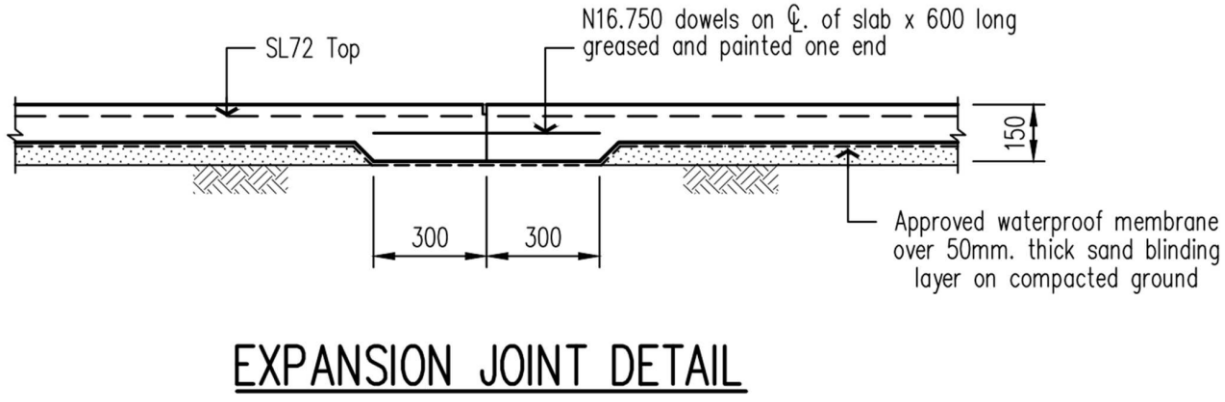
2.13.2.5 Joints

2.13.2.5.1 Synthetic Grass

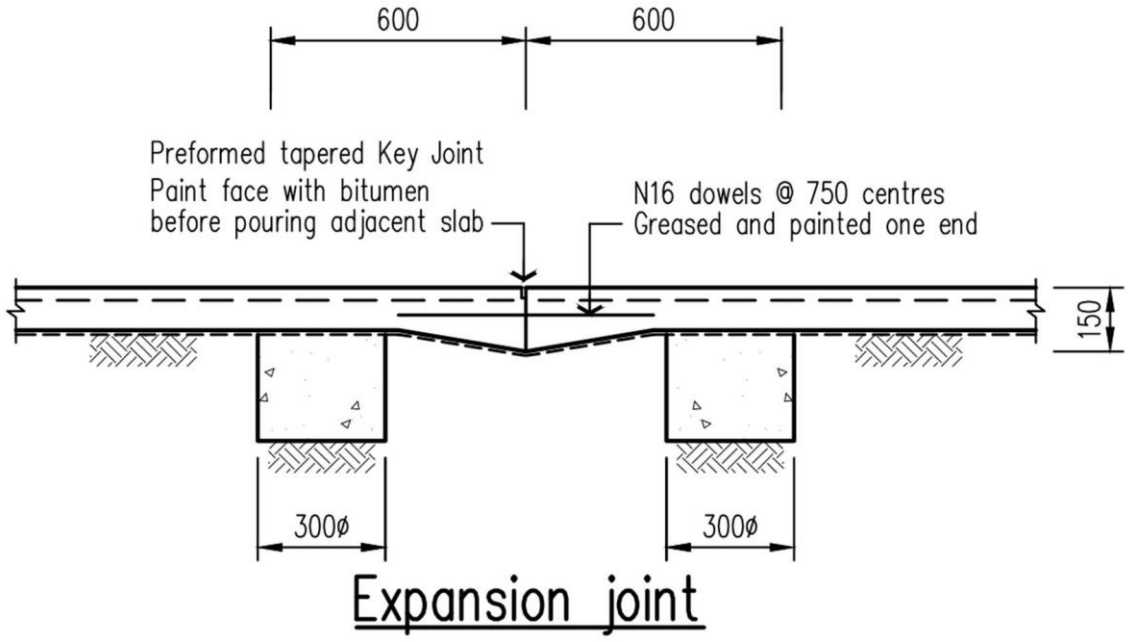
It is not imperative to construct joints when the slab is to be overlaid with synthetic grass, however sometimes it is desirable to place 3mm saw cuts in the slab to isolate sections of the pavement.

2.13.2.5.2 Synthetic Acrylic

A full construction joint should be installed under the net line of the court to create two independent slabs. Within 48 hours of the concrete pour a series of 3mm x 30mm saw cuts shall be cut along the base lines and up the centre of the court to minimise random cracking.



EXPANSION JOINT DETAIL



Expansion joint

Examples of expansion joint designs

2.14 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 players' expectations. As the range of surfaces used by different sports is wide, different requirements and construction limitations apply, depending on the type of surface being installed.

Synthetic grass sports court

2.14.1 Regularity or evenness

The surface regularity of a newly-built or resurfaced sports court should conform to the following specifications.

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, or expose a player to a significantly increased risk of injury within the perimeter of the court.

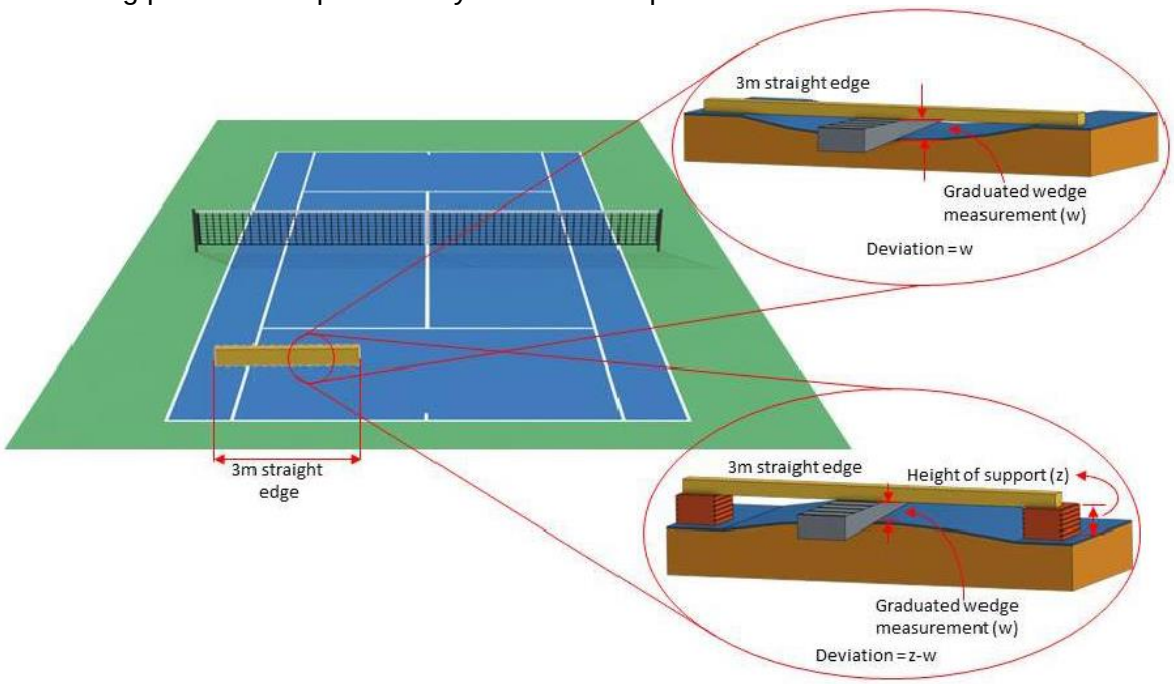
Subject to the above, the surface should be laid to a tolerance in accordance with the figure below: 'Maximum permitted undulation under 3.0m straight edge'. A certain number of deviations (of up to 4) are permitted from the recommended evenness limits shown in the table when measured under a 3.0m straight edge – provided that, when measured under a 1.0m straight edge, the deviation does not exceed the recommended evenness limit for that surface type.

Deviations over 1000mm in length are multiple deviations (e.g. a 1.8m long ridge is two deviations, one of 1m length and one of 0.8m length). The allowed tolerances for checking the surface level using a 3.0m straight edge are:

Surface type	Recommended evenness limits	Max. number of possible deviations	
		PPA	TPA
Asphalt	8mm	4	8
Artificial grass on single asphalt layer	6mm	2	4
Impervious acrylic on concrete or asphalt	8mm	4	8
Polymeric	8mm	4	8

Maximum permitted undulation under 3m straight edge: ITF

The following procedure is provided by the ITF in respect of tennis:



Procedure for testing undulation under 3.0m straight edge: ITF

3.0m straight edge

Calculation of results

Record the location, magnitude, direction (bump or dip) and orientation of all deviations outside the recommended limits. If any such deviation occurs in both test orientations (parallel to and at right angles to the net), then it should only be counted once. Deviations exceeding 1m in length shall be counted per metre, or part thereof. For example, a deviation (above the recommended limit) 2.5 m long shall equate to three deviations. The test value is the number of deviations outside the recommended limits for the surface type.

Evenness, slope and planarity recommendations for a tennis court

	Acrylic/ Polyurethane	Artificial clay/ grass; carpet; hybrid clay	Asphalt/ concrete; other[1]	Clay	Grass
Evenness	6 mm		8 mm	6 mm	
Deviations[2]	2 (PPA)/4 (TPA)		4 (PPA)/8 (TPA)	N/A[3]	
Slope (max)	1:100 (1.00%)	1:120 (0.83%)		1:200 (0.50%)	
Planarity[4]	± 15 mm from true (PPA) ± 30 mm from true (TPA)				

Evenness, slope and planarity recommendations for a tennis court: ITF

1. Specifications are for porous constructions. For impervious constructions, see ‘acrylic’.
2. In no instance should any imperfection exist that could cause the ball to deviate significantly from its path on a level surface or expose a player to a significantly increased risk of injury within the perimeter of the court.
3. Deviations on clay or grass over 6mm should be corrected where possible.
4. Unless design, specification or construction necessitate otherwise.

EVENESS (ITF CS 02/02)

The court surface should be free from any imperfection that causes an inconsistent ball bounce, allows the collection of water, or significantly increases the risk of injury to players. Undulations in the court are measured relative to a rigid straight edge placed on the surface.

Apparatus

Test apparatus consists of:

- 3.0 m straight edge made from box-section aluminium or equivalent.
- Wedge approximately 25mm wide and 200mm long, with marked height increments of 1mm.
- Two supports for the straight edge, of equal height.

Calibration of apparatus

Devices used for evenness measurements should be calibrated annually for straightness of the edge against a known standard to ±0.5mm. Surveying-quality straight edges in serviceable condition are deemed appropriate. The straight edge can be checked by hanging a plumb line against the bottom edge. The wedge increments and supports can be measured using a calliper, calibrated against a known standard to ±0.25 mm. Check for any damage to the straight edge and wedge prior to testing.

Test Procedure

1. Lay the straight edge on the surface, parallel to the net, and look for deviations that warrant measurement, i.e. which exceed the recommended limit in table accompanying Figure 35.
2. If there are any hollows, measure the point of maximum deviation from the underside of the straight edge using the graduated wedge (see Figure 36). Ensure that the straight edge is resting on the court surface either side of the hollow.
3. If there are any isolated bumps or ridges, suspend the straight edge above the peak of the bump using supports at either side (see Figure 36). Measure the point of minimum deviation from the underside of the straight edge using the wedge and subtract this value from the height of the supports. This gives the height of the bump.
4. Measure the length of the deviation by moving the straight edge either side of the maximum point, parallel to the net, until the deviation no longer exceeds the recommended limit in Figure 35.
5. Move the straight edge to an adjacent location and repeat steps 1 to 4, making sufficient measurements to inspect the Total Playing Area (TPA) of the court).
6. Repeat steps 1 to 5, with the straight edge at right angles to the net.

SLOPE AND PLANARITY (ITF CS 03/03)

Ideally, a tennis court should be a flat surface lying in a single horizontal plane. The court may be sloped for drainage, but the single plane of the surface should always be maintained. The slope should be oriented to minimise its effect on play. Thus, where a court must be sloped for drainage, the court can be a slope from side-to-side, end to end or diagonally. The slope is determined by measuring the ratio of change in elevation to horizontal distance. Planarity is measured relative to a hypothetical plane parallel to the slope of the court.

Example of orientation of a diagonally sloping tennis court: ITF

2.14.2 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 in-situ water infiltration rate of sports surfaces. Suppliers will typically design and test around laboratory values for vertical permeability as in EN 13108. As the surface ages, its porosity will gradually decline, because of contamination with dirt, vegetable matter, fluff from tennis balls etc. The maintenance guidelines in Section Three should be followed to limit this decline.

Note: Immediately after construction, 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.

2.14.3 Surface texture

Sports 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 to minimise textural variations.

Some degree of textural variation is, however, inherent in certain materials and laying procedures used for sports court surfacing, such as bitumen asphalt. Such variations are acceptable if 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.

2.14.4 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.

2.14.5 Initial settling down period

Most sports 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.

2.14.6 Corrective/remedial action

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

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.

2.15 PAINT COATINGS AND BINDERS FOR ASPHALT COURTS

2.15.1 Asphalt curing

If a court is painted before the bitumen incorporated in the asphalt has been allowed to harden adequately, the paint may not cure satisfactorily. 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 coating. The time it takes for oxidation to occur will vary depending on 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.

Painting should only be undertaken in fine, dry, relatively still weather. This makes programming challenging for contractors and delays are a common occurrence.

After being applied to the asphalt surface, the paint dries to the stage where it is touch dry, and at this stage it starts its initial curing. This can take between one and twelve hours, depending on temperature, humidity and air movement.

Coating should only be undertaken when the surface and ambience temperatures of the surface to be coated are above manufacturers' recommendations. Coatings should be mixed according to the manufacturer's instructions and applied at the recommended application rates.

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.

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

As lines sometimes 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.

2.15.2 Slip resistance

The paint used to coat the base 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 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 surface, provides adequate grip in dry, wet and damp conditions.

Different sports have different requirements for slip resistance. It is important to appreciate that the level of grip required for netball will result in quite an abrasive finish to the court surface.

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:

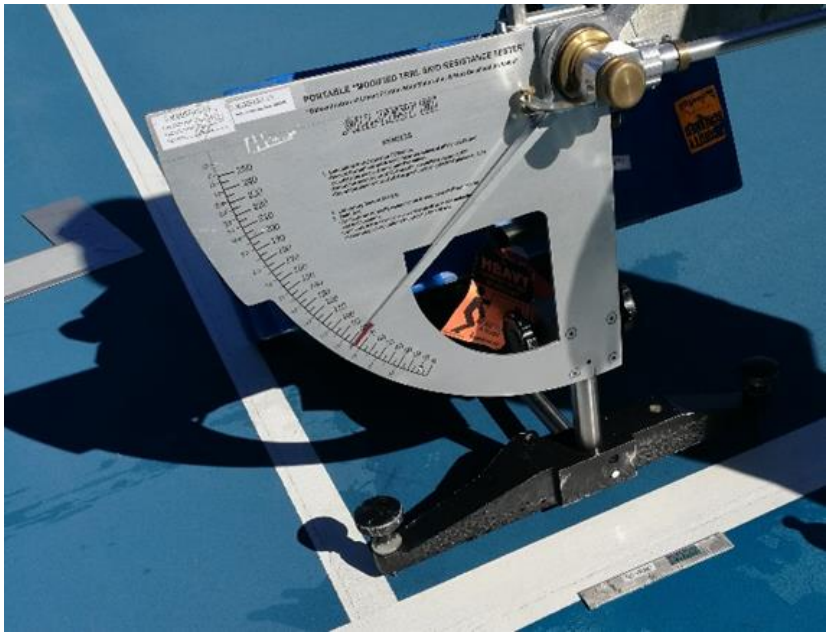
- the type of footwear used on the court
- the frequency with which the court is cleaned and debris is removed
- the amount of usage
- the formulation of the coating – water-based coatings can soften if exposed to moisture for prolonged periods, making the coating more prone to wear
- the size of particle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

While the use of paints with a texturing agent has overcome many of the problems of slipperiness associated with painted courts, there is a limit to their ability to provide high levels of grip in damp conditions, particularly after drizzle or heavy dew. Also, differential drying of courts due to site conditions may give rise to differences in grip between areas on a court which can cause issues for players.

The friction or slip resistance of the playing surface is measured using the test procedure described in:

AS/NZS 4663: Slip resistance measurement of existing pedestrian surfaces,
AS/NZS 4586: Slip resistance classification of new pedestrian surface materials.

The measuring device consists of a pendulum and rubber foot that can slide across the court surface. The resistance to the foot sliding across the surface is recorded and expressed as a measure of slip resistance.



Tennis court traction tester

For the minimum value of slip resistance for different court use, refer to the sporting governing bodies.

Example:

1. Multi-sport surfaces specify 55 -110 BPN (British Pendulum Number).
2. Building Code of Australia requirements have a slip resistance rating for surfaces. Standards Australia HB 198:2014 slip recommendations:

   Table 3A – HB 198:2014 "Guide to the specification and testing of slip resistance of pedestrian surfaces" Standards Australia Limited 2014.

   Table 2 - AS 4586-2013 "Slip resistance classification of new pedestrian surface materials".

CLASSIFICATION OF PEDESTRIAN SURFACE MATERIALS ACCORDING TO THE AS 4586 WET PENDULUM TEST

Class	Pendulum SRV (see Note 1)	
	Slider 96	Slider 55
P5	>54	>44
P4	45–54	40–44
P3	35–44	35–39
P2	25–34	20–34
P1	12–24	<20
P0	<12	

NOTES:

1 While Slider 96 or Slider 55 rubbers may be used, the test report shall specify the rubber that was used.

2 It is expected that these surfaces will have greater slip resistance when dry.

3 SDV may be calculated by using the tables that are given in Appendix F, and the minimum SRV that is considered appropriate for a level surface (see examples given in Appendix F).

AS/NZS 4586: Slip resistance classification of new pedestrian surface materials

Netball Slip Requirement

To ensure a safe surface for netball play, each new outdoor playing surface (hard courts) should ideally achieve a mean British Pendulum Number (BPN) of at least >75, tested by a company accredited by the National Association of Testing Authorities (NATA). In the absence of a netball specific standard, testing should be in line with the most relevant Australian Standard, i.e: AS 4663:2013: Slip Resistance measurement of existing pedestrian surfaces, for existing surfaces. A minimum of five individual locations should be tested on each playing court using both slider 55 and slider 96, and shall ideally achieve a mean BPN of at least 75 for both sliders.

2.15.3 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
- the spillage of fluids, including fuels, solvents and some fizzy drinks

2.16 SAND-FILLED ARTIFICIAL GRASS

2.16.1 General

The range of sand-filled artificial grass surfaces is large and the many different types have a variety of differing playing qualities. Therefore it is not possible to establish a comprehensive specification for the quality of the carpet that all products will achieve.

2.16.2 Weather considerations

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

2.16.3 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 areas are out of tolerance, overlaying with a new asphalt or concrete base surfacing course is normally the most effective approach. When laying a new asphalt layer, the edgings of the court should be raised to contain the new layer of asphalt and to prevent wind getting under the synthetic grass carpet and lifting it (if the carpets are loose laid).

2.16.4 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 the checking of the rolls, the installation should proceed in accordance with the manufacturers' recommendations.

2.16.5 Sand application

If the carpet is not correctly sanded prior to play, the surface will not perform correctly and its durability will be compromised. This part of the installation is therefore crucial. Before infilling, it is recommended that the entire surface is brushed to aid the turf fibre to stand upright. The sand should be applied evenly in stages ensuring that the sand is brushed into the pile in such a way that the pile remains upright. Extreme care and attention should be taken when applying the sand. The dressing must be finished to a constant depth within the base of the pile.

If using a wheeled vehicle to transport sand across the surface, make sure that the tyres are smooth – tyres with treads such as herring bone tyres may mark the playing surface. The recommended ground pressure of tyre to turf surface is between 8 and 11 pounds per square inch. 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.

It is recommended and often required by the contract that PPE is worn at all times during construction, but this is essential while the delivery and application of sand is in process. Refer to sand suppliers' MSDS (materials data safety sheet) for details on the type of mask required when using their sand products.

2.17 IMPERVIOUS ACRYLIC SURFACES

2.17.1 Preparation of asphalt or concrete base

Tolerances for surface regularity are given earlier in 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 accurately 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. Some deeper depressions may require a second application after the first one has set.

Concrete sub-bases may have saw cuts which can be filled with a similar compound, again supplied by the surface manufacturer. Due to the movement at these joints, however, 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. Curing accelerators in the concrete mix should not be used unless recommended by the manufacturer.

2.17.2 Surfacing layers

The first layer to be applied over an asphalt 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 asphalt and provide a strong, even surface as economically as possible. The colour may not be the same as the 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 asphalt 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. After acid etching, 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.

2.17.3 Cushion coats

Various degrees of cushioning may be incorporated into the surface by including 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.

2.17.4 Coloured layers

The name given to these layers and the number of layers required varies depending on the manufacturer, they consist of a binder (typically 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 court 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.

2.17.5 Weather considerations

All the water-based products made for these systems are limited to being applied within certain temperatures, as per coatings manufacturer’s recommendations, to ensure proper film formation. 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 optimal. Application should never commence when rainfall is imminent.

2.17.6 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 texturising additives as well as water. Thorough mixing is essential with all types of material.

The mixed material is normally transported onto 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 asphalt, the trolley tyres should be pneumatic to prevent depressions being made in the asphalt.

Mixing surfacing materials for netball court complex

2.17.7 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 – especially if using a petrol driven machine, when it is important to prevent any fuel spillages 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.

Coating of netball courts

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.

Applying line marking to basketball court

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

2.18 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 an asphalt base, or supplied in factory produced rolls that are bonded to an asphalt base.

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

Polymeric surfaces should meet the relevant requirements of BS EN 14877: *Synthetic Surfaces for Outdoor Sports Areas: 2013*. At the time of publication of this Code of Practice, Standards Australia are discussing the possible adoption of BS EN 14877 in Australia.

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 surface is being 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.

Line marked polymeric surfaced court

2.19 TENNIS NETS AND POSTS

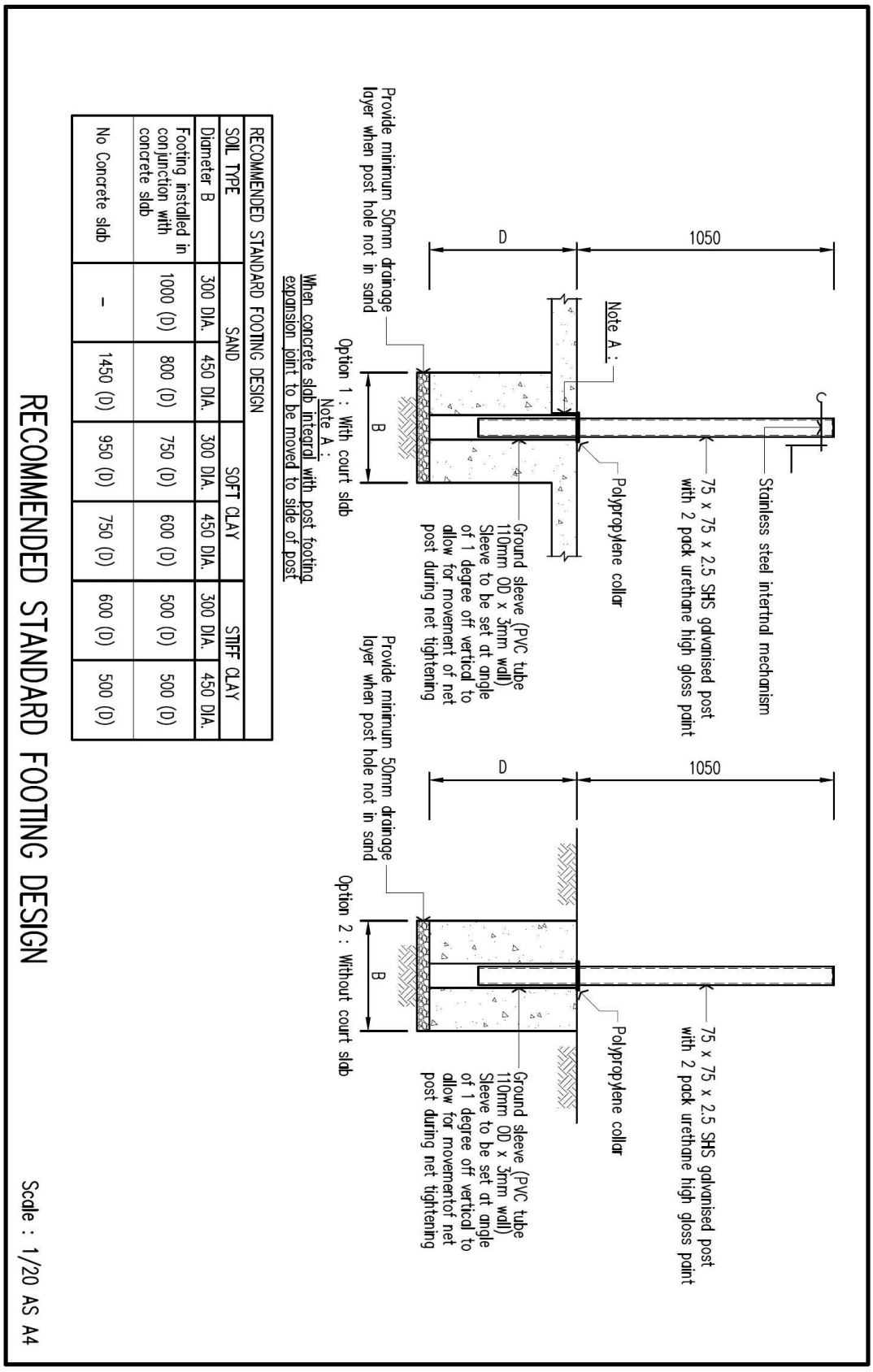
2.19.1 Net posts

Net posts should be round or square, with internal or external winding mechanisms. The centre of the posts shall be 0.91m outside the court side lines.

The height of the posts shall be such that the top of the metal cable shall be 1.07m above the playing surface at the net post location, and 900mm above the playing surface at the court centre.

Example of square tennis net posts

Net posts (or sleeves for net posts) shall be placed in a 20MPa (minimum) concrete footing, being 350mm diameter and 600mm depth (minimum), but may vary relative to subgrade soil type conditions. As a guide to installation, see the Net Post Recommended Standard Footing Design below.



RECOMMENDED STANDARD FOOTING DESIGN

RECOMMENDED STANDARD FOOTING DESIGN						
SOIL TYPE		SAND		SOFT CLAY		STIFF CLAY
Diameter B		300 DIA.	450 DIA.	300 DIA.	450 DIA.	300 DIA.	450 DIA.
Footing installed in conjunction with concrete slab	1000 (D)	800 (D)	750 (D)	600 (D)	500 (D)	500 (D)
No Concrete slab	1450 (D)	950 (D)	750 (D)	600 (D)	500 (D)	500 (D)

Scale : 1/20 AS A4

Notes regarding net post installation:

- The hole could be 'belled' out or widened at the bottom. Widening of the base of the hole (belling) can be of benefit when the post is restrained by the slab but is of less benefit when the post has no slab restraint. The top section of the footing usually governs due to bending forces induced by the net tension, meaning the belling has minimal benefit.

- The vast majority of netposts are installed in a sleeve, not direct cast into the slab. Sleeving of net posts can result in some play due to tolerances allowing the posts to move in the sleeve. The sleeve can allow moisture ingress to the subgrade, potentially causing heave. Ensure that sleeve is sealed fully to slab and sealed at base (fully concreted or capped with end plate), allowing for movement.

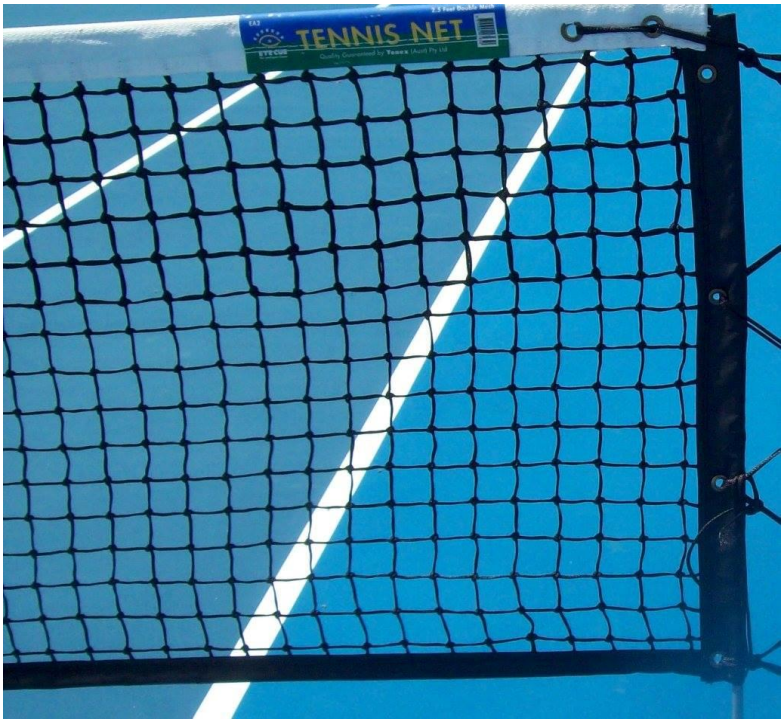
- The concrete surrounding the netpost in the footing should be isolated from the underside of the slab – not poured all in one – especially if the surface is acrylic. Typically, the centre expansion joint runs 'through' the netpost hole. Having the slab isolated from the footing may prevent cracking around the netpost. Isolation of the netpost footing to the slab is preferred if the surface finish is critical (e.g. acrylic surface) but is not as much a problem for synthetic grass (as the slab is hidden). Any movement of the slab relative to the post can cause issues, the location of the joints in the slab becomes more important if the posts are cast with the slab. Any moisture ingress can cause possible heave etc. Joints on the net line need to be waterproofed. The base of the post needs to be waterproofed and allow for some movement.

- Netpost sleeves should be angled slightly outwards so that when 'tensioned' up with the net, they pull up straight. This tension in the net should be governed by the expected shape of the net. Generally 2kN (204kg force, 450 lbf) is considered adequate. The issue with angling of posts and then tensioning to straighten is the possible overload of the footing, post, or mechanism. The use of a spring on the net cables can reduce the tension placed on the net cable. Angling of posts to take movement of sleeves is acceptable.

Example of common type of tennis net post baseplate mounting

2.19.2 Tennis nets

Tennis nets are generally 760mm drop or full drop. Refer to manufacturer's guidelines relative to various net qualities, and attachment to net posts.



Close up of tennis net

2.19.3 Tennis net centre strap

Woven centre strap with suitable steel attachment set in concrete footing (200mm diameter, 150mm depth), central to net line.

2.20 SURROUND FENCING

At the time of publication, the only existing Australian Standard for sports fencing relates to tennis court fencing. Other sports either do not routinely utilise fencing, or else fencing is for security of the facility only. The following notes refer to tennis court fencing.

2.20.1 Commercial Tennis Courts complying with AS1725-2010-Part-2

Commercial tennis court fencing

Commercial tennis court fencing

Fence Design Options

(a) Top and bottom pipe rail with 3 mid cables (preferred option)
(b) Top pipe rail only with 3 mid and 1 bottom cable (4 cable wires)
(c) Bottom pipe rail only with 3 mid and 1 top cable (4 cable wires)
(d) Rail-less with corner bracing with 3 mid and 1 top and 1 bottom cable (5 cable wires)

Nominal Height of Chain Link Fabric (mm)	Type of Post / Rail or Stay	Nominal Size Pipe (DN)	Outside Diameter (OD)	Wall Thickness (mm)	Pipe Grade	Minimum Concrete Footing Diameter (mm)	Minimum Concrete Footing Depth (mm)
3600 preferred or optionally 3000	Draw Net Posts	DN100	114.4	4.5	Medium	300	1200
	Corner Posts	DN80	88.9	4.0	Medium	300	900
	End Posts	DN80	88.9	4.0	Medium	300	900
	Intermediate Posts	DN50	60.3	3.6	Medium	250	750
	Pipe Rails	DN40 or DN32	48.3	3.2 3.2	Medium	N/A	N/A
	Bracing Rail for braced panel	DN40 or DN32	48.3 42.4	3.2 3.2	Medium	N/A	N/A
	Diagonal Bracing Stay for braced panel	DN40	48.3	3.2	Medium	250	750
	Optional Back Stays (Twin Leg)	DN40	48.3	3.2	Medium	250	600
	Pedestrian Single Gate 1000 to 1200 width	DN25	33.7	2.6	Light	N/A	N/A
	Vehicle Double Gates 3000 to 4000 width	DN32	42.4	2.6	Light	N/A	N/A

Pipe and Footing Tables for Commercial Tennis Court Fencing

NOTES:
1. Extra Light Wall Pipe is not permitted to be used with Commercial Tennis Court Fencing with AS1725-2010-Part-2.
2. Post spacing shall be evenly spaced, not exceeding 3.330m.
3. Light poles, where required, must comply with manufacturers' requirements and supported with engineering design.
4. Powder coating of pipe when specified shall comply with AS4506 to same colour as chain link.

Preferred Range of Chain Link Fabric for Commercial Tennis Courts

(a) Heavy duty 3600mm high x 45 pitch x 3.15mm wire fabric is preferred.
(b) Chain link fabric shall comply with AS2423.

Preferred Fabric Height (mm)	Pitch or Mesh Size (mm)	Core Wire Diameter (mm)	Wire Coating	Selvedge edge of chain link fabric	Fabric Service Duty
3600	45	3.15	Heavily Galvanized W10Z (HG)	Knuckled both ends (KK)	Heavy Duty
3600	45	3.15	Polyvinyl Chloride (PVC)	Knuckled both ends (KK)	Heavy Duty
3600	45	3.15	Fusion Bonded Coated (FBC)	Knuckled both ends (KK)	Heavy Duty

NOTES:
1. Standard colours for PVC coatings are Black or Evergreen. PVC is an extruded plastic coating over the base core wire.
2. Standard colour for Fusion Bonded coating is Black. Fusion Bonded is a polymer coating glued to the base core wire.
3. Chain Link shall be secured to the playing side of posts and strained taut between 1.0 to 1.2 kN to ensure the chain link diamonds cannot separate more than 5mm with a hand squeeze test.
4. Chain link or bottom rail must be set close enough to playing surface to retain tennis balls.

2.20.2 Domestic Tennis Courts complying with AS1725-2010-Part-3

Domestic tennis court fencing

Fence Design Options

(a) Top and bottom pipe rail with 2 mid cables (preferred option)
(b) Top pipe rail only with 2 mid and 1 bottom cable (3 cable wires)
(c) Bottom pipe rail only with 2 mid and 1 top cable (3 cable wires)
(d) Rail-less with corner bracing with 2 mid and 1 top and 1 bottom cable (4 cable wires)

Nominal Height of Chain Link Fabric (mm)	Type of Post / Rail or Stay	Nominal Size Pipe (DN)	Outside Diameter (OD)	Wall Thickness (mm)	Pipe Grade	Minimum Concrete Footing Diameter (mm)	Minimum Concrete Footing Depth (mm)
3000 preferred or optionally 3600	Draw Net Posts	DN100	114.4	4.5	Medium	300	1200
	Corner Posts	DN65	76.1	3.6	Medium	300	900
	End Posts	DN65	76.1	3.6	Medium	300	900
	Intermediate Posts	DN40	48.3	3.2	Medium	250	600
	Pipe Rails	DN32	42.4	2.6	Light	N/A	N/A
	Bracing Rail for braced panel	DN32	42.4	2.6	Light	N/A	N/A
	Diagonal Bracing Stay for braced panel	DN40	48.3	3.2	Medium	250	750
	Optional Back Stays (Twin Leg)	DN32	42.4	2.6	Light	250	600
	Pedestrian Single Gate 1000 to 1200 width	DN20	26.9	2.3	Light	N/A	N/A
	Vehicle Double Gates 3000 to 4000 width	DN25	33.7	2.6	Light	N/A	N/A

Pipe and Footing Tables for Domestic Tennis Court Fencing

NOTES:
1. Extra Light Wall Pipe is not permitted to be used with Domestic Tennis Court Fencing with AS1725-2010-Part-3.
2. Post spacing shall be evenly spaced, not exceeding 3.330m.
3. Light poles, where required, must comply with manufacturers' requirements and supported with engineering design.
4. Powder coating of pipe when specified shall comply with AS4506 to same colour as chain link.

Preferred Range of Chain Link Fabric for Domestic Tennis Courts

(a) Light duty 3000mm high x 45 pitch x 2.50mm wire fabric is preferred.
(b) Chain link fabric shall comply with AS2423.

Preferred Fabric Height (mm)	Pitch or Mesh Size (mm)	Core Wire Diameter (mm)	Wire Coating	Selvedge edge of chain link fabric	Fabric Service Duty
3000	45	2.50	Heavily Galvanized W10Z (HG)	Knuckled both ends (KK)	Light Duty
3000	45	2.50	Polyvinyl Chloride (PVC)	Knuckled both ends (KK)	Light Duty
3000	45	2.50	Fusion Bonded Coated (FBC)	Knuckled both ends (KK)	Light Duty

NOTES:
1. Standard colours for PVC coatings are Black or Evergreen. PVC is an extruded plastic coating over the base core wire.
2. Standard colour for Fusion Bonded coating is Black. Fusion Bonded is a polymer coating glued to the base core wire.

3. Chain Link shall be secured to the playing side of posts and strained taut between 1.0 to 1.2 kN to ensure the chain link diamonds cannot separate more than 5mm with a hand squeeze test.
4. Chain link or bottom rail must be set close enough to playing surface to retain tennis balls.

2.20.3 General Fencing Requirements applicable to both Commercial and Domestic Tennis Courts

Fittings

Fittings for connection of posts, rail and stays shall be either Downee / Elgate or equivalent (hot dip galvanized) clamp-on fittings and shall be firmly secured to posts, rail and stays with all nuts facing away from playing side of fence.

Cable and Lacing Wires

Cable and lacing wires shall be the same coating quality as per Chain Link Fabric.

Single Strand Helicoil Cable Wires

Shall be 4.0mm core wire strained taut between 1.0 to 1.2 kN and double cross tied to posts with 2.00mm core wire**.**

Optional Twin Twist Cable Wires

Shall be two strands of 3.15mm core wire twisted together taut between posts to achieve 1.0 to 1.2kN.

Lacing Wire

Shall be 2.00mm core wire laced taut through each diamond to all Top and Bottom rails, plus Gate, End and Corner posts.

Ties to Posts

Wire ties to posts shall be 2.00mm core wire single strand or twin 1.57mm to tie chain link firmly to all intermediate posts, ties shall be located centrally between all cable wires , twisted twice with ends cut short and folded back flat to posts to avoid risk of injury.

"C" Clips to Secure Chain Link to Cable Wires

Either 2.00mm or 2.30mm wire "C" clips are preferred with blunt ends only (to avoid risk of injury). Clips shall be clipped to all cable wires at 320mm maximum spacing (each 4th diamond).

2.20.4 Recommendations when Wind Break Material Added to Surround Fencing

Care must be taken if a request is made to attach wind break material to sports court fencing. There have been instances of fencing failing when 1800 high wind break material was fitted to the chain link fencing surrounding the courts.

Technically each project should be assessed and subject to a geotechnical report to confirm ground conditions.

As an example, the following tables are footing depths recommendations provided for both footings tied to the slab and footings not tied to the slab. Note that this table refers to 'Region A'

installations only – for identification of Area A please refer to the map below the tables (roughly southern and central Australia).

For explanation of factors T1, T2 and T3, refer to notes below the tables:

When Pier Footing IS NOT tied to the slab:

MIN. POST FOOTING DEPTHS (millimeter)FOR
300mm DIAMETER SIZE
***PIPE GRADE: C250LO**

***FENCE DETAILS REFER ARCHITECTURAL DRAWINGS**

FREE PIER FOOTING - NOT TIED TO SLAB				
STIFF CLAY, Cu=75kPa				
Post Spacing	**Description**	**TC1**	**TC2**	**TC3**
1800	Post Size	114.3 x 4.5 CHS	88.9 x 4.0 CHS	88.9 x 4.0 CHS
	Footing Depth	1200	1100	1000
2100	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	88.9 x 4.0 CHS
	Footing Depth	1300	1200	1100
2400	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1400	1300	1200
2700	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1500	1400	1300
3000	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1600	1500	1400
3300	Post Size	n/a	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1700	1600	1500

FREE PIER FOOTING - NOT TIED TO SLAB				
VERY STIFF CLAY, Cu=125kPa				
Post Spacing	**Description**	**TC1**	**TC2**	**TC3**
1800	Post Size	114.3 x 4.5 CHS	88.9 x 4.0 CHS	88.9 x 4.0 CHS
	Footing Depth	1100	1000	900
2100	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	88.9 x 4.0 CHS
	Footing Depth	1200	1100	1000
2400	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1300	1200	1100
2700	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1400	1300	1200
3000	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1500	1300	1200
3300	Post Size	n/a	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1500	1400	1300

When Pier Footing IS tied to slab:

MIN. POST FOOTING DEPTHS (millimeter)FOR
300mm DIAMETER SIZE
***PIPE GRADE: C250LO**

***FENCE DETAILS REFER ARCHITECTURAL DRAWINGS**

PIER FOOTING - TIED TO SLAB				
STIFF CLAY, Cu=75kPa				
SPACING	**Description**	**TC1**	**TC2**	**TC3**
1800	Post Size	114.3 x 4.5 CHS	88.9 x 4.0 CHS	88.9 x 4.0 CHS
	Footing Depth	900	800	700
2100	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	88.9 x 4.0 CHS
	Footing Depth	900	800	800
2400	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1000	900	850
2700	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1050	900	900
3000	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1100	1000	900
3300	Post Size	n/a	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	1100	1000	1000

PIER FOOTING - TIED TO SLAB				
VERY STIFF CLAY, Cu=125kPa				
SPACING	**Description**	**TC1**	**TC2**	**TC3**
1800	Post Size	114.3 x 4.5 CHS	88.9 x 4.0 CHS	88.9 x 4.0 CHS
	Footing Depth	700	650	600
2100	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	88.9 x 4.0 CHS
	Footing Depth	750	700	600
2400	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	800	750	700
2700	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	850	800	700
3000	Post Size	114.3 x 4.5 CHS	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	900	850	750
3300	Post Size	n/a	114.3 x 4.5 CHS	114.3 x 4.5 CHS
	Footing Depth	950	900	800

Site Exposure Factors T1, T2 and T3:

Australian/New Zealand Standard 1170.2:2011 lists terrain/height, shielding and topography as exposure multipliers affecting fencing design.

Terrain, over which the approach wind flows towards a structure, is assessed on the basis of the following category descriptions:

(a) Terrain Category 1 (TC1)
Very exposed open terrain with few or no obstructions and enclosed, limited-sized water surfaces at serviceability and ultimate wind speeds in all wind regions, e.g. flat, treeless, poorly grassed plains; rivers, canals and lakes; and enclosed bays extending less than 10 km in the wind direction.

(b) Terrain Category 1.5 (TC1.5)
Open water surfaces subjected to shoaling waves at serviceability and ultimate wind speeds in all wind regions, e.g. near-shore ocean water; large unenclosed bays on seas and oceans; lakes; and enclosed bays extending greater than 10 km in the wind direction. The terrain-height multipliers for this terrain category shall be obtained by linear interpolation between the values for TC1 and TC2 in the table above.

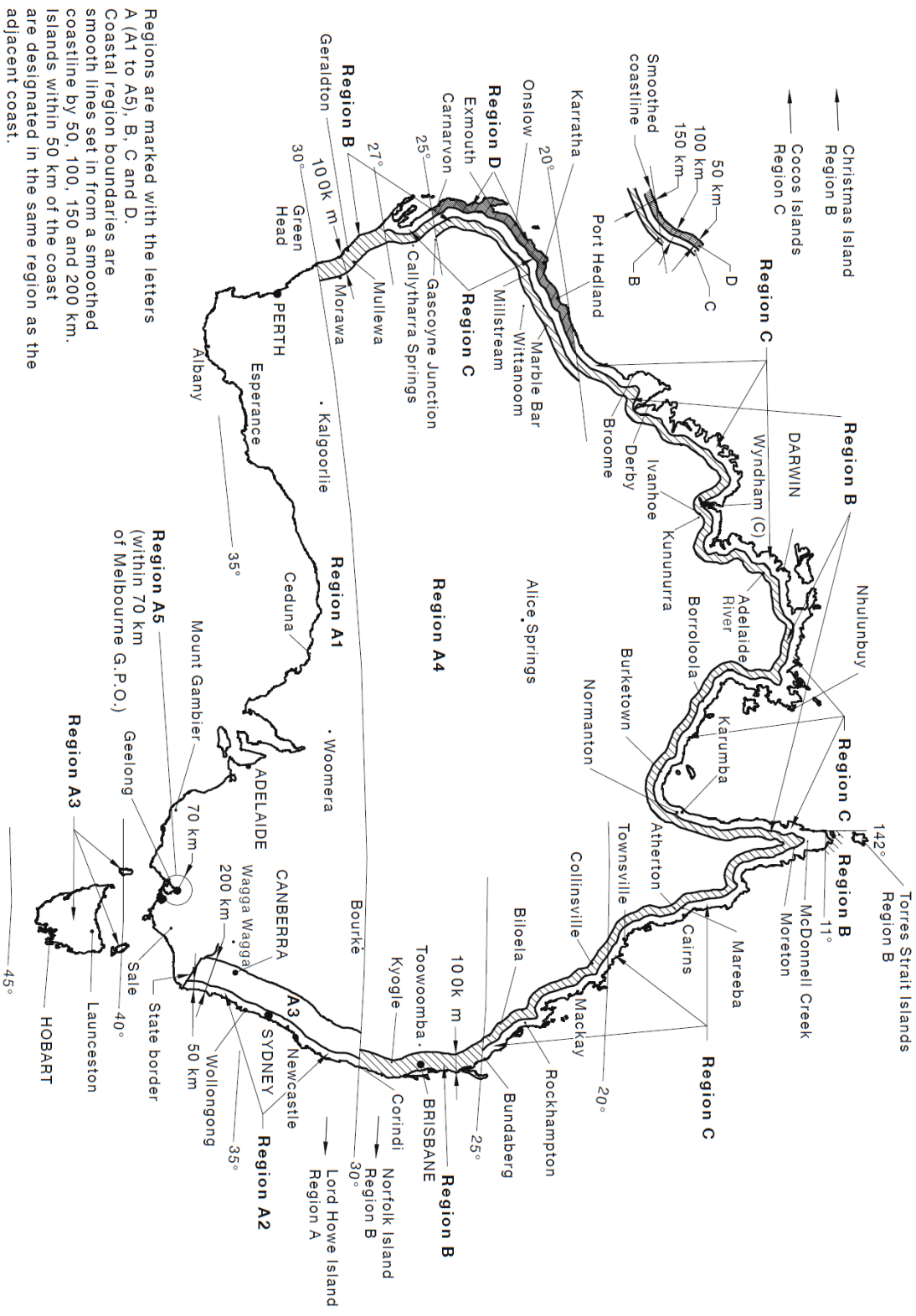
(c) Terrain Category 2 (TC2)
Open terrain, including grassland, with well-scattered obstructions having heights generally from 1.5 m to 5 m, with no more than two obstructions per hectare, e.g. farmland and cleared subdivisions with isolated trees and uncut grass.

(d) Terrain Category 2.5 (TC2.5)
Terrain with a few trees or isolated obstructions. This category is intermediate between TC2 and TC3 and represents the terrain in developing outer urban areas with scattered houses, or large acreage developments with fewer than ten buildings per hectare. The terrain-height multipliers for this terrain category shall be obtained by linear interpolation between the values for TC2 and TC3 in the table above.

(e) Terrain Category 3 (TC3)
Terrain with numerous closely spaced obstructions having heights generally from 3 m to 10 m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare, e.g. suburban housing, light industrial estates or dense forests.

(f) Terrain Category 4 (TC4)
Terrain with numerous large, high (10 m to 30 m tall) and closely-spaced constructions, such as large city centres and well-developed industrial complexes.

Selection of the terrain category should be made with due regard to the permanence of the obstructions that constitute the surface roughness.



Regions are marked with the letters A (A1 to A5), B, C and D.
Coastal region boundaries are smooth lines set in from a smoothed coastline by 50, 100, 150 and 200 km. Islands within 50 km of the coast are designated in the same region as the adjacent coast.

WIND REGIONS OF AUSTRALIA

SECTION THREE

MAINTENANCE

3 Section Three – Maintenance

3.1 GENERAL COURT CARE COMMON TO ALL SURFACES

3.1.1 Footwear

Good quality sports 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 and may invalidate surface warranty. 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, children’s playthings and heavy items such as wheelbarrows full of sand which could damage the surface. Family pets should also be excluded.

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

3.1.3 The court perimeter

A strip of ground at least 0.5m wide outside the surround fence should always be kept clear of vegetation 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. Trees which can cause can cause major disturbance of the surface include Casuarina, Paperbark, Lilli Pilli, Morton Bay Fig, Liquidamber, Eucalypt, Camphor Laurel, Poplar, Australian Indigo, Golden Robinia, Ficus, Weeping Willow and Pride of Bolivia. 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 must 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 cockatoos as well as bats, can cause damage especially to painted asphalt surfaces during the summer months. For all these reasons overhanging branches should be pruned well back.

3.1.6 Substances to keep away from sports courts

Cigarettes
All sports courts should be made “no smoking” areas. 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 sports courts. Chewing gum is invariably difficult to remove, although some people advise 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 garden vacuum cleaners, are clean and in good repair and do 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 rule, salt or other de-icing agents should never be used to remove snow or ice from sports courts. Their effect is unpredictable and they may cause serious damage.

3.1.7 Weeds

Before constructing the court, the installer will have removed visible weeds. 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 removal has been carried out inefficiently. 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 be 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.

3.1.7.1 Treating weeds

All grass, weeds, seedlings and shallow rooted plants should be treated with a suitable weed killer. Deep-rooted weeds, such as thistles, convolvulus, 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.

3.1.7.2 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 despite the spot treatment described above, advice should be sought from either the installer or a specialist weed-killing company.

3.1.8 Maintenance of Tennis 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 made available 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 further still. 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, after first being 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 the part of the posts which fits into the sockets. This can greatly facilitate the removal of the posts, especially if they are left in position for long periods.

Example of tennis net external winder

3.1.9 Maintenance of Basketball and Netball Equipment

In relation to basketball and netball equipment, SAPIA Member Grand Slam Sports Equipment (www.grand-slam.com.au) specify the following maintenance should be conducted at a minimum of a six monthly intervals –

Netball: -

- Routine checks on fastenings – i.e. ring to post bolt connections;
- Routine checks on weld joints;
- Routine checks on net and net to ring connection;
- Routine checks of inground sleeves to ensure they are clear of debris or water.

Basketball: -

- Routine checks on all bolt connections – ensuring they are in place and tight;
- Routine visual checks on weld joints on the entire structure;
- Check ring is level / if ring is adjustable it should be adjusted so it is level;
- Routine visual check on backboard, net and net to ring connection;
- For reversible structures, lubrication should be applied to rotating assemblies to ensure ease of ongoing operation.

3.2 MAINTENANCE OF SAND-FILLED ARTIFICIAL GRASS SPORTS COURTS

3.2.1 Introduction

Most sand-filled artificial grass sports courts consist of a permeable sub-base, usually of asphalt, upon which is laid a tufted, polypropylene or polyethylene 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 differential colour. Occasionally play-lines are painted onto the surface, but these are decidedly temporary and need frequent re-painting.

The resulting 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.

3.2.2 Maintenance Overview

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;
- The court should always look attractive and well-kept .

These objectives are achieved by:

- Sweeping and/or blowing 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.

3.2.3 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/blower 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/blowers 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).

Leaf blower

3-foot broom

3.2.3.1 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 (91.44cm) 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”. Weekly brooming 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 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.

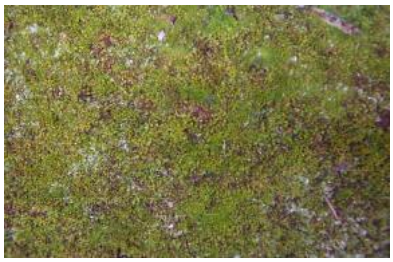
If, in spite of the regular brushing described above, or as a result of a lack of it, the sand-filled surface becomes over-compacted and impervious, this condition can often be corrected by appropriate treatment, usually involving the use of specialist machinery. Machines vary from simple scarifiers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

3.2.4 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 the part of the surface which 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, if it is not oil-based. The manufacturer's instructions should be closely followed. Some installers can supply specially formulated moss-killers.


Slime Mould


Red-orange algae on white lines


Common moss-seen mostly in winter

Moss and algae growth in SFAG tennis courts

An example of a SFAG tennis court which requires professional cleaning

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 can become established. Regular brooming and use of the court renders moss an even less likely problem.

3.2.5 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.

Acceptable level of sand in newly-constructed SFAG tennis court

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.

3.2.6 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.

3.2.7 Stain removal

Most stains can be removed 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 methylated spirits.

3.2.8 Weeds

No matter how much care is taken, weeds may occasionally appear on the surface, usually because 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.

3.2.9 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.

3.2.10 Footwear and general court care

Good quality footwear should always be used. 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.

3.2.11 Maintenance schedule

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 / algaecide
- 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 regimen or the condition of the court, the installer should be contacted. It is better to be safe than sorry.

3.3 MAINTENANCE OF ACRYLIC COURTS

3.3.1 Maintenance Overview

The maintenance procedures are designed to ensure that:

- the playing surface is kept scrupulously clean, to preserve its playing characteristics
- 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
- washing the court surface regularly to keep it clean

3.3.2 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.

3.3.3 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 provide a 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 surface should subsequently be maintained in accordance with the recommendations.

3.3.4 Maintenance schedule

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 regimen or the condition of the court, the installer should be contacted. It is better to be safe than sorry.

3.4 MAINTENANCE OF SHALE AND CLAY COURTS (TENNIS ONLY)

3.4.1 Introduction

Unlike all other types of tennis surface in common use today (barring 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 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 if adequate resources can be made available to maintain them, and there is a strong commitment to apply those resources on a permanent basis. However, it also can 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 Australian clay courts or decompressed granite courts. The difference is that the typical Australian 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 Australian 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 groundskeeper must

be allowed to take over – and for which there is no written substitute, if the best results are to be consistently achieved.

3.4.2 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, fine shale or gypsum is frequently added to improve the cohesive qualities of the surface, or "bind".

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.

The maintenance regimens that are recommended for the various surfaces in this general category all centre around first wetting the surface and then rolling it. The surface must also 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.

3.4.3 Tools and equipment

The basic equipment needed is:

- motorised roller and/or hand roller

- broom - semi stiff 3 foot wide
- broom - soft 3 foot 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.

Nowadays, motorised rollers take most of the hard work out of the operation of rolling and greatly speed 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 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 fate 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.

The brooms or brushes should not be less than 915mm in width. They should be dragged and not pushed. The semi-stiff broom, which works as a "scarifier", can be wider still – although 1,500mm is about the widest that can be managed. The soft broom, which is for final preparation work, is plenty wide enough at 3 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.

A 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. A 19mm bore is minimum, with 25mm 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.

3.4.4 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.

3.4.4.1 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 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.

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 groundskeeper.

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 groundskeeper 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

3.4.4.2 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 groundskeeper will keep his 'weather-eye' open and take notice of the weather forecast. It may save him a great deal of work (and water bills). Failing rain, the water must be applied artificially by one of these methods:

- hand watering with a hose pipe
- portable sprinkler
- permanent irrigation equipment

Hand watering

This is a good method only if the water supply is copious and the pressure reasonably high. However, with a 25mm hose and a coarse spray the job can be done remarkably quickly. The disadvantage is that the operation is labour intensive, but there are also advantages. The water can be put exactly where it is needed, in exactly the right quantity. No automatic sprinkler is capable of this.

The water should be directed slightly upwards to allow the water to fall on the surface, rather than being aimed straight at it, as it might wash away.

Always apply plenty of water, sufficient to soak right through the surface. Soaking only 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 many 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 boasting a 12.5mm hosepipe. These should be avoided in preference for simple, robust designs which 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 will blow off the court area, or evaporate before it can soak in.

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

Remember:

- thoroughly soak the surface right through
- rain is the best watering system of all, be prepared so as to take advantage of it

3.4.4.3 Brushing

After watering and before rolling, the surface should 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.

3.4.4.4 Rolling

Rolling is ostensibly a very simple operation, but one in which the basic principles are 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. Therefore, a double cylinder roller with rounded edges makes the operation easier and less likely to cause damage. These recommendations are 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 is and wherever the shear-line is located, the result is the same. The uppermost part of the surface becomes 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 beginning 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 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. Much like the patterns left on a grass court by a 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 groundskeeper 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 always be clean. 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.

3.4.5 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.

3.4.6 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.

3.4.7 Salt in winter

Traditional Australian clay or shale surfaces are designed to be used during open weather all year round. They are, however, quickly put out of action by frost and this can happen through winter. To reduce the effect of frost, common salt may be used.

3.4.8 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.

3.4.9 The post-construction phases

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 - more elderly players are the ideal candidates for breaking in a new surface. Vigorous singles should be kept for later. The groundskeepers must be allowed to dictate the extent and scheduling of this early use, to enable them to water and roll the court before the new surface becomes unduly disturbed. Having said this, the more the new court is used and the more regularly, therefore, it must 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.

3.4.10 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 facility manager, players and the groundskeepers. The groundskeepers must be aware, sufficiently in advance, of the intended schedule of use, and they must be able to dictate changes in the schedules if they are 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 DETAILED MAINTENANCE RECOMMENDATIONS FOR SPECIFIC SURFACE TYPES

This section has dealt so far with general maintenance principles and procedures 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”) / Decomposed granite
- Other water-bound surfaces

3.5.1 Fast-dry

This surface, 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.

While there are only a small number in Australia, 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.

3.5.1.1 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 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, in addition, at least three times per month. Rolling should be carried out in alternate directions 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 at least 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 bricklayer's trowel or similar tool. 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 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 winter
During winter in colder regions of Australia, the surface may have lifted and become puffed up because of frost action. In this condition, it retains a lot of water. In 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.

3.5.2 French clay

The surface layer of ‘French clay’ courts 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 overdone. Only sufficient water should be applied to re-soak the 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 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 highly accurate surface levels, so that puddles do not form. The coin test is a good one. If standing water is deeper than a fifty cent 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.

3.5.2.1 Routine maintenance

At the end of the day
After play has finished for the day, the whole surface should be drag-matted, following the careful repairing of 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, 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 in colder regions
With the first frost of autumn, the court must be put out of use until the next playing 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 may 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 September), 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 must be broken down with a rake, taking care always 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 the restoration work and line-painting, before play commences. Initially play should be carefully controlled and the performance of the surface carefully monitored.

3.5.3 UK shale or blaes

This so-called “all-weather” surface is primarily found in the southern Australian States. However, the high cost of maintaining the “En-tout-cas” surface has resulted in it being systematically

replaced at many venues. 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 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 as 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, large 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 used 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 25mm apart). This will achieve an even better joint between the new and the old.

Repairing a flaked or sheared surface
This is one of the most difficult problems which is 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 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 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. There is no quick and easy way of dealing with shearing. 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 repeatedly 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 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 August/September. 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 then 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 then 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 groundsman’s instructions should be followed carefully.

3.5.4 Other water-bound surfaces

Other similar water-bound surfaces still exist. Courts made from decompressed granite/”Ant Bed” are the most common. All of these and various other similar surfaces may be maintained by following the general principles set out in this Code of Practice. Their 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 asphalt and a playing surface made from a coloured polyurethane binder and rubber crumb or powder, applied directly to the asphalt, 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 Maintenance Overview

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 and provides a good surface for playing tennis whenever required
- 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
- applying prophylactic treatments of moss-killer and algaecide

3.6.3 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 tends 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 achieve a good result. 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.

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. 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.

3.6.4 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 perimeter and other areas which are not trafficked, especially if they are shaded by walls or buildings or overhung by trees. Any good proprietary product should be satisfactory if 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 can 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.

3.6.5 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.

3.6.6 Re-colouring the surface

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

3.6.7 Play-lines

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

3.6.8 Maintenance schedule

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 regimen or the condition of the court, the installer should be contacted. It is better to be safe than sorry.

SECTION FOUR

RENOVATION & RECONSTRUCTION

4 Section Four - Renovation & Reconstruction

4.1 INTRODUCTION

Resurfacing (renovating) an existing sports court with a similar surface 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 (upgrade or conversion) may have implications that are 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, goal or net-post sleeve/footings 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 may 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, while 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 the following:

4.2.1 Tree roots

Tree roots which 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 barrier 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. Care also needs to be given to avoid unauthorised work to trees protected by a tree preservation order (TPO) or within a conservation area.

4.2.2 Drainage

A common indication that an existing surface needs 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 several general considerations that may result in extending the scope and extent of the work involved in resurfacing a sports court. In the following pages each of the standard types of sports court are examined to establish the likely implications of the choice of a new surface. Resurfacing with the same surface as the existing (renovation), is usually relatively straightforward. The decision to specify a different surface (reconstruction), however, can have far reaching implications. 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 remains suitable for the game and type of surface following renovation or reconstruction, all works should be undertaken to the same standards and tolerances as used for new courts (see Section 2).

4.3.1 Resurfacing asphalt with asphalt (renovation)

The major considerations determining resurfacing or reconstruction procedures are:

- the levels of the existing surface
- the integrity of the existing surface
- the total construction depth of the existing court

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.

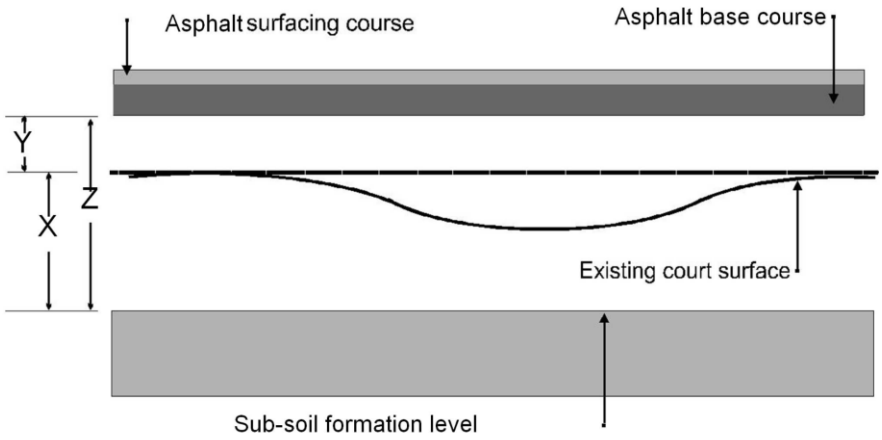
Lack of attention to the level of perimeter kerb foundations, at the time of original construction, can lead to surface water being trapped in the sub-base structure of the court. This fault will be manifested as slow surface water drainage, despite having drilled the surface as above. Remedial action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

A bituminous asphalt 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 asphalt 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 asphalt before laying the new surface, but this should not be necessary if a base-course is being provided.

Asphalt correction layer

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:

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

Asphalt correction layer equation: SAPCA

Cracks in the existing asphalt should not be a threat to the new surface if the movement which caused them has long since ceased. Resurfacing an asphalt 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.

4.3.2 Resurfacing asphalt with artificial grass

If the existing asphalt 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 further improve the drainage, the existing asphalt may be pierced at 450mm centres over its entire area, or in areas where the drainage is particularly impaired, such as around the baselines. However, this should not be necessary if the original asphalt platform has the appropriate crossfall – normal standard is 1%.

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.

Resurfacing asphalt with synthetic grass

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

cracks or defects in the existing base can be ground and patched with acrylic patching product. Most acrylic surface manufacturers have suitable patching products.

When assessing the suitability and integrity of the existing asphalt as a base for the new surface, the requirements of Section 4.3.1 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 the carpet.

4.3.3 Resurfacing asphalt with acrylic

If the existing asphalt surface and its foundations are stable, sufficiently level and laid to an appropriate gradient, it may be possible to lay an acrylic surface directly upon it. Some acrylic systems include a levelling/sealing compound which can seal and fill the asphalt. It is important to establish that the impervious acrylic system selected is capable of being used in this way.

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

In most cases, however, existing asphalt surfaces will not be laid to an adequate gradient to shed rain-water e.g. 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.

Extensive patching on old asphalt courts prior to resurfacing

4.3.4 Replacing an existing asphalt surface

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

Nevertheless, it is possible to remove an asphalt 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 asphalt.

When assessing the suitability and integrity of the existing asphalt as a base for the new surface, the technical requirements 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 asphalt base has remained level and porous, the old sand-filled artificial grass surface merely must be replaced with a new one. In doing so, it is important not to allow the asphalt base to become contaminated, especially by sand from the old surface. No attempt should be made to reuse the sand.

If the asphalt base has lost its level or become slow-draining, consideration must be given to replacing it or superimposing a new asphalt layer, having first restored the drainage of the existing asphalt layer.

4.5 RESURFACING ACRYLIC COURTS

4.5.1 Resurfacing acrylic courts with acrylic (renovation)

If acrylic courts are well-specified and well-built in the first place, they can be "resurfaced" at relatively 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 asphalt, or to remove the top 25mm or so of the existing asphalt sub-base and replace it. A completely new impervious acrylic surface is then built up.

Basketball court before and after renovation

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 with 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 asphalt, 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.

Resurfacing a shale or clay court with asphalt, 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. Note: If appropriate, renovation or reconstruction is performed which results in a very stable platform, it may be used as the base for the installation of sand filled artificial grass.

4.7 RESURFACING POROUS CONCRETE COURTS

Porous concrete courts will all be very similar, being constructed in rectangular bays or slabs 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, 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.

4.7.1 Resurfacing porous concrete with artificial grass

If the porous concrete surface is in good condition with little or no movement at the joints, it may be possible to lay 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.

APPENDIX A
SPORTS FIELD LIGHTING ILLUMINATION REQUIREMENTS

SPORTS FIELD ILLUMINATION REQUIREMENTS

Sport	Level of play	Maintained Illuminance (Eh lux)	Minimum horizontal uniformity		Maximum Glare rating	Maximum uniformity gradient	Reference standard
			U1 Min/Avg	U2 Min/Max			
Tennis	**Recreation & residential:**						
	Principal playing area (PPA)	250 (at 1m)	0.6	0.3	50	N/A	AS 2560.2.1
	Total playing area (TPA)	150 (at 1m)	0.2	0.1	50	N/A	
	Club competition & commercial:						
	Principal playing area (PPA)	350 (at 1m)	0.6	0.4	50	N/A	
	Total playing area (TPA)	250 (at 1m)	0.3	0.2	50	N/A	
	International & national :						
	Principal playing area (PPA)	1000 (at 1m)	0.7	0.5	50	N/A	
	Total playing area (TPA)	800 (at 1m)	0.5	0.3	50	N/A	
Touch Football	**Recreation:**	50	0.3	N/A	N/A	N/A	AS 2560.2.3
Soccer Rugby Union Rugby League AFL	**Amateur:**						AS 2560.2.3
	Ball & physical training	50	0.3	N/A	N/A	N/A	
	Club completion & match practice	100	0.5	0.3	50	N/A	
	Semi-professional level:						
	Ball & physical training	50	0.3	N/A	N/A	N/A	
	Match practice	100	0.5	0.3	50	N/A	
	Semi-professional competition	200	0.6	0.4	50	N/A	
	Professional level:						
	Ball & physical training	100	0.5	0.3	50	N/A	
	Match practice	200	0.6	0.4	50	N/A	
	Professional competition	500	0.7	0.5	50	20% per 5m	

SPORTS FIELD ILLUMINATION REQUIREMENTS

Sport	Level of play	Maintained Illuminance (Eh lux)	Minimum horizontal uniformity		Maximum Glare rating	Maximum uniformity gradient	Reference standard
			U1 Min/Avg	U2 Min/Max			
Basketball Netball	**Outdoor:**						AS 2560.2.4
	Recreation, training & competition with few spectators	100	0.5	N/A	N/A	N/A	
	Competition with large spectator galleries	200	0.66	N/A	N/A	N/A	
	Indoor:						AS 2560.2.2
	Recreation & training	300 (at 1m)	0.5	N/A	N/A	N/A	
	Competition	500 (at 1m)	0.7	N/A	N/A	N/A	
Swimming	Recreation or training	120	0.5	0.3	N/A	N/A	AS 2560.2.5
	Club, Interclub or district competition	240	0.6	0.4	N/A	N/A	
	International, national or state competition	600	0.7	0.5	N/A	N/A	
Hockey	Physical training	30	0.25	N/A	N/A	N/A	AS 2560.2.7
	Ball training, junior & minor grade competition	250	0.6	N/A	N/A	N/A	
	Major grade club, national & international competition	500	0.7	N/A	N/A	N/A	
Lawn Bowls	Competition, recreation & training	100	0.6	0.4	50	30% per 2m	AS 2560.2.8
Croquet	Competition, recreation & training	150	0.6	0.4	50	N/A	Croquet facility guide (Croquet Victoria)
Futsal	**Indoor:**						
	Competition, recreation & training	500	0.7	N/A	N/A	N/A	Futsal stadium requirements. Football NSW