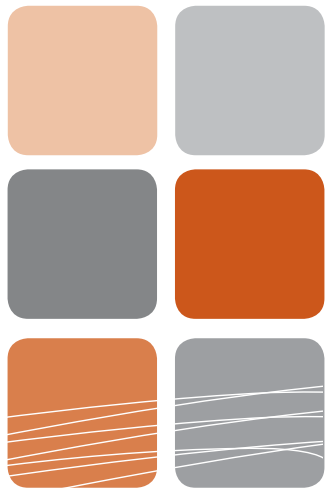


Artificial Grass For Sport

Part 2 of 8



1.3 History of Artificial Grass

1st Generation Artificial Grass

The development of synthetic fibres and their integration into a carpet to try to simulate the conditions of natural grass was first successfully achieved by the Monsanto company in the United States of America at the Moses Brown School, Providence, Rhode Island in 1964.

Two years later, Monsanto's high-density knitted nylon product was installed in the indoor Houston Astrodome following the failure of natural grass to grow under the stadium's translucent roof. Originally called Chemgrass, but nicknamed 'Astroturf' by the media, this early-phase artificial grass was not popular with baseball players or spectators. Many other USA stadiums also tried artificial grass around this time, but as per the Astrodome, they all eventually returned to natural turf.

By the mid-1970s these First Generation artificial grass pitches (low-pile height, high-density of fibres) had improved to the point where an artificial grass pitch was successfully used for the hockey tournament at the 1976 Olympic Games in Montreal.

Made of nylon (polyamide) yarns, first generation pitches were coarse and capable of causing friction burns and wounds unless played on wet - as per the hockey model. They were not UV proof.

As was to be the case with a number of other sports (eg. soccer, lawn bowls) the first artificial grass applications were not a perfect match for baseball (and American football), but the door had been opened to a new world of exciting sporting surface possibilities.



1st Generation Artificial Grass

© Loughborough University; www.sportsurf.lboro.ac.uk

- 10 – 12 mm fibre length, integral shock pad developed 1960s, nylon, unfilled, hard, abrasive
- Used for hockey at the 1976 Montreal Olympics

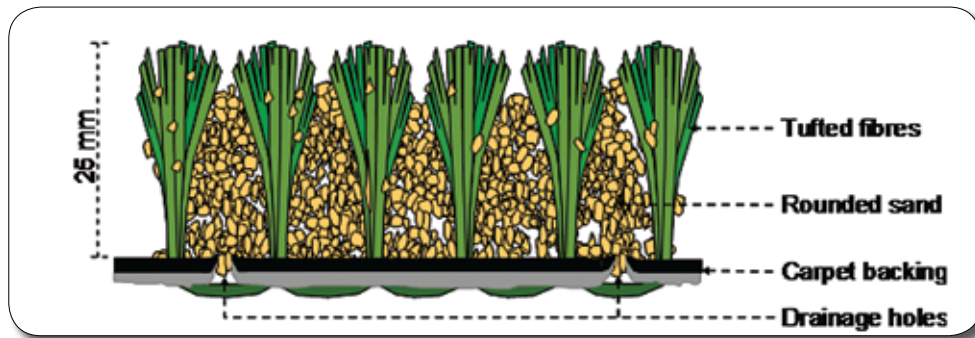
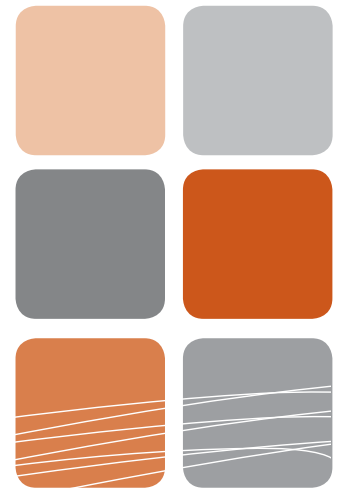
2nd Generation Artificial Grass

London-based soccer club Queens Park Rangers were the first to install a 'Second Generation' artificial pitch (medium pile height – lower density 20 to 35mm of fibres, filled with sand to provide stability and some control of ball bounce) and by the mid-1980s there were four second generation artificial grass pitches in operation in the English soccer leagues.

Now made of polypropylene these versatile and durable pitches were

immediately successful for community level soccer and other activities but at the top level of soccer they soon lost currency as the ball bounced too high for the professionals, and player footing was not reliable enough for that level of the game. Soon these major clubs reverted to natural grass.

This situation continued for another decade, with the low-pile height, high-density carpets (first generation) being ideal for hockey, but a suitable artificial grass system for competition soccer was still some time away.



2nd Generation Artificial Grass

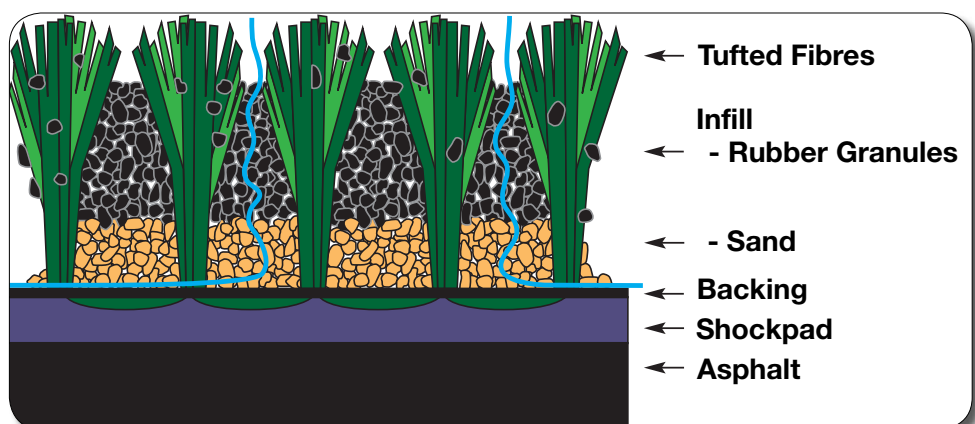
© Cranfield University 2008 www.cranfield.ac.uk

- 20 – 35mm fibre length, monofilament or fibrillated polypropylene, wider spaced tufts, rounded sand infill
- Developed late 1970s, initially no shock pad
- UK professional soccer – banned 1980s for being unplayable

3rd Generation Artificial Grass

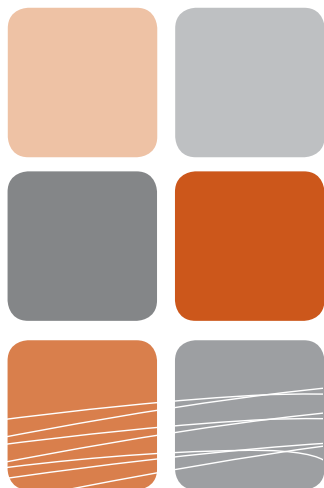
Third Generation carpets (longer pile – 35-65mm, dressed with sand/ rubber granules/both) were introduced in Europe in the late 1990s, and have developed, particularly because of the adoption of the softer polyethylene based fibre and the ability of the surface to take a normal stud, into a very acceptable surface for sports such as soccer and rugby union. The rubber infill, sometimes with a shock pad as well

for added safety (rugby's initial preference), have made third generation artificial grass carpets more acceptable for most sports where a player might occasionally slide, fall to the ground, or land from height. These third generation pitches are now becoming popular for soccer in Australia, and will increasingly be seen in coming years being used for Australian rules football and cricket (outfields), and for multi-sport usage.



3rd Generation Artificial Grass

- Long-pile (40 – 65mm, 65mm = rugby union)
- Monofilament/fibrillated fibres, sand/rubber infill • Developed late 1990s



4th Generation Artificial Grass

Developments so far this century could be gathered under the heading of Fourth Generation artificial grass carpet systems, and these would include:

- For soccer and rugby type use:
 - Variations on the third generation model, utilising a mix of monofilament, textured fibres of variable lengths without infill.
- For hockey type use:
 - Sand-dressed pitches which are a variation on the second generation sand-filled pitches. Sand-dressed pitches have a much-reduced sand content (50-80 per cent of the 12-13mm crimped pile height). The lack of surface-level sand aids faster ball movement and reduces the severity of any abrasions for falling or sliding players.
 - Dry pitches for elite level hockey: a variation on first generation pitches (high-density of low-pile height fibres), but now using polyethylene fibre so that these pitches can be used dry at times when field watering is not possible or desired. This latter development represents the artificial grass industry's initial response to the

International Hockey Federation's push to find an elite playing level carpet system (high-density, low-pile height) that does not require watering. Certain carpets have already been manufactured, installed and tested to 'Global' level (the highest level available), where no water is required.

- For athletics field games:
 - Super long-pile turf (typically 80mm in height, infill to typically 60mm), with sufficient depth to absorb (without damage) thrown objects – such as discus, hammer, shot put and javelin.
- For tennis type use:
 - The development of synthetic clay. This product involves artificial grass infilled with reddish coloured sand (single size granules so as to minimise compaction). Is a waterless alternative to en-tout-cas courts (see photo on page 108).

Examples of these fourth generation soccer, hockey and tennis facilities are now in place in Victoria, while the first prototypes of long-pile pitches for Australian rules football/cricket use are also being installed.

1.4 Benefits and Disbenefits

1.4.1 Benefits

- High-quality and consistent surface (even ball roll/bounce).
- Generally requires no water. An effective response to reduction in availability of potable water due to drought and climate change.
- Relatively low maintenance requirements (in comparison with the labour-intensive natural turf regimes – which also often require professional turf maintenance skills and large machinery).
- More tolerant of adverse weather conditions.
- Can be programmed intensively both in terms of time bandwidth (day and night), as well as subdividing field space and increasing participation.
- Has the potential to generate significant rental income, given intensive programming.
- Potential for multi-use.
- Can reduce the impact that sport has on a player's joints and the body generally due to the placement of shock pads and rubber granular infill.
- Cleaner to play on (ie. no mud).
- Can be used to collect water to aid local irrigation.
- Costs marginally more than natural turf in the long-term, yet allows up to three to four times more hours of use.
- Increases predictability of sports fixtures and events.

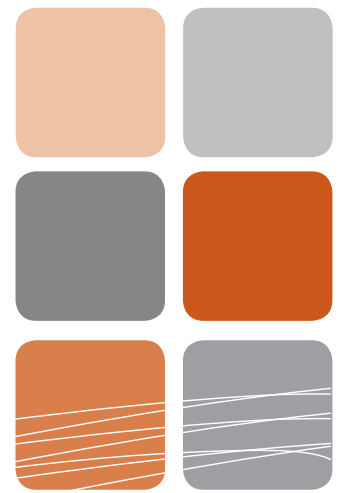


Somerville Secondary College

1.4.2 Disbenefits

- High initial capital cost.
- Sometimes requires high fencing to protect the facility.
- Costly to repair if damaged.
- Heat retention and reflection can be an issue in certain circumstances.
- Some facilities are more likely to be single use.
- Requires upgrade or replacement every eight-fifteen years.
- The variability of performance across the range of high value to low value surfaces, and the difficulty for new adopters to differentiate.
- Perception that they are more expensive to establish, maintain and upgrade – refer to Section 1.10 and Appendix 5.
- Perception of increased injury potential (refer to Section 1.8).
- Perception of negative environmental impact (refer to Section 1.16).
- Perception of negative health impacts (refer to Section 1.16).
- The potential for ‘unintended’ differential user charges (artificial V natural surfaces) to evolve. See item 1.11.3.

A UK survey (Cranfield Survey², 2008) looking at annual average maintenance costs (in the UK) suggests expenditure per hour averaging out at: artificial grass - \$7 AUD per hour of use, natural turf - \$70 AUD per hour of use. Refer to Appendix 5 for some Australian based cost-benefit modelling.



1.5 Types of Artificial Grass and Infill

1.5.1 Fibre base materials

Artificial grass carpet is manufactured with yarn from two groups of polymer: polyolefin, which includes polypropylene and polyethylene; and the less common polyamide (nylons). Blends of polymers are also used. They are modified chemically to produce different properties of durability, fibre resilience, frictional resistance and resistance to weathering.

1.5.2 Production methods

Artificial grass carpet is generally produced in one of two ways.

(i) Tufting is the most common type of manufacture where the fibre is tufted into a primary backing cloth, normally made from woven polypropylene or urethane, and the individual tufts are anchored by the application of a latex-based secondary backing material. These backing layers also contribute to the dimensional and structural stability of the carpet.

(ii) Needle-punching is where the fibre in the pile forms both the pile structure and the majority of the backing cloth. The fibres are needled into a flat primary

cloth, then secondary needled to pull through and angle the fibre to a felt-like structure of the desired quality and configuration of pile.

Artificial grass can also be produced through knitting and weaving methods (used for some bowls carpets), but is rarely used because of its greater expense.

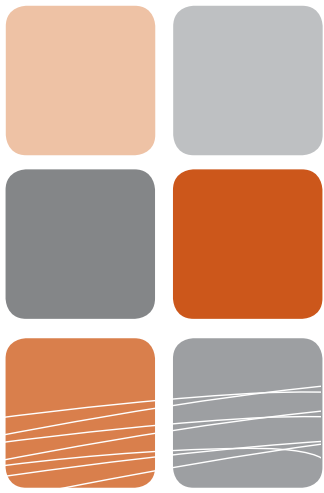
1.5.3 Types of artificial grass

Type according to infill content

(i) Unfilled

Unfilled pitches were the first type of system implemented for sport. They had short pile height, were dense in quantity and had no infill material. They were often made of nylon, which meant the prototypes were often tough and abrasive. Partly due to the abrasiveness, watered unfilled fields were developed and have since been popular for elite levels of hockey. The water is applied through an irrigation system to the surface immediately before play, and it reduces the player-to-surface friction, modifies the speed of the hockey ball and cools the surface in hot weather. It

²Cranfield University, UK Survey, 2008 - See Bibliography



can require a lot of water to maintain the playing characteristics, during a match or training session.

Due to the cost of the high-density unfilled carpet, required irrigation systems, and water, unfilled carpet technology is now focused on producing non-watered unfilled carpet that can replicate the playing characteristics of watered fields. The key change is from abrasive nylon fibre to softer polyethylene yarn. Several such polyethylene-based installations are being trialled in Australia.

(ii) Dressed

Dressed systems are a derivative of the sand-filled system, and intermediate in properties and playing characteristics between the traditional filled and unfilled carpets. They can have either:

- a shorter, denser pile than the standard filled system (with a reduced quantity of sand fill of about 60% of the fibre height) which are considered suitable for hockey, soccer (training), touch rugby, lacrosse and cricket (fielding practice).
- the longer pile (35-65mm) used for soccer, rugby, Australian rules football and cricket, which is dressed with sand, rubber granules or both to within about 15-20mm of the top of the fibre.

(iii) Filled

With filled artificial grass systems, the artificial grass fibres or blades are fully supported or stabilised by the addition of a filling material, such as sand, clay and rubber granules, or a mix of sand and rubber granules. These carpets are marginally less expensive than non-filled systems because the pile density can be reduced due to the sand fill, which is normally taken to within 5-6mm of the fibre tips. The sand and fibres combine to form the characteristics of the playing surface.

Artificial grass surfaces that are filled with sand only are generally suitable for hockey, tennis, lawn bowls, touch rugby, lacrosse, and soccer (training) and multi-function use. See Section 1.6 for more details on sport specific requirements.

Types according to pile height

Short-pile turf

(i) Unfilled

High-density of fibres and used predominantly for cricket pitches (either 8, 10 or 12mm in pile height, or for elite level hockey pitches generally 10-12mm). The unfilled hockey pitches have, until now, had to be kept wet to improve foot traction, ball speed and heat suppression, but suppliers are now responding to the call from the International Hockey Federation to develop a dry unfilled carpet that can perform to elite level standard.

(ii) Dressed

Nominally 10-13mm high with medium-pile density, sand-dressed carpets are a hybrid development midway between sand-filled and elite unfilled pitches. Becoming popular in Australia for hockey, dressed carpets (sand filled to approximately 60% of the pile height) are also suitable for lacrosse, and for training for soccer, Australian rules football, touch rugby and cricket (fielding practice).

Medium-pile turf

(i) Filled

These carpets are in the range of 20-35mm and have traditionally been the hard-wearing sand-filled carpets used for hockey, tennis, lawn bowls and for training level activities for a variety of other sports.

(ii) Dressed

An interesting and recent development is the approval of soccer pitches in Europe that have sand infill and a shock pad instead of rubber granule infill and no shock pad. Because of the lack of rubber granule infill, the pile height can be lower than the typical third generation dressed pitch.

This product may be similar to the new Australian Football League (AFL) and Cricket Australia-approved artificial grass surface, and might be the first example of a hybrid design that is close to meeting both AFL and Federation Internationale de Football Association (FIFA) specifications.

Long-pile turf

(i) Dressed

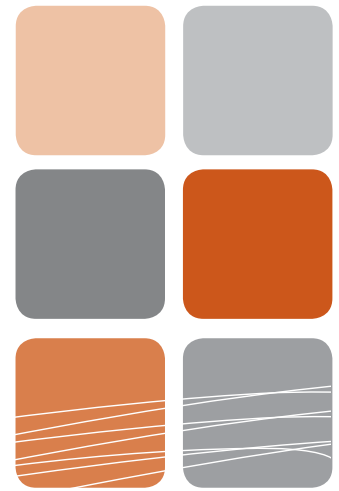
Long-pile turf has long blades of fibre similar in height to some natural turf

playing surfaces. The long fibres (40-65mm in length) provide cushioning and allow for a great amount of infill to be integrated into the pitch adding to the shock absorbency and force reduction characteristics of the ground, and plays more like grass. These fibres can be monofilament (single fibre) or multi-ended filament yarns (brush-like at the tip), and are proving to be popular for soccer, rugby, Australian rules football/cricket and golf.

The pitch infill is comprised of a sand layer at the base with, typically, (recycled) rubber granules above the sand layer. The total infill height is generally between one half and two thirds of the pile height. Some sports (eg. rugby) may also need to have a shockpad under the 'turf'.

The shortest of the long-pile turfs (35 – 40 mm) are targeted at Australian rules football and cricket (outfield) usage, and provide an 'acceptable' surface for some competitive soccer and hockey (lower levels of competition and school usage). A 55 – 65 mm pile height is the recommended soccer turf height, whilst rugby recommends 65 mm, often with a shock pad as well. Refer Appendix 8 for summary table.

The latest development with long-pile turf is the development of even longer fibre carpet (80-85mm, with approximately 60mm of infill material). This is being hailed as the first suitable artificial grass system for athletics field events including hammer, shot put, discuss and javelin.



Top Tip:

In your project specifications, clearly nominate the minimum face weight (the weight of the yarn that is visible above the carpet backing) of the product to be installed. The heavier the face weight the longer the service life.

Top Tip:

Include the following formula (for determining yarn face weight) in your specification. It looks complex, but manufacturers know what it means:

Yard Face Weight (YFW) = FPH X SR X D X EPM

Where:

EPM = No. of rows of stitches per metre (1000/machine gauge)

D = Decitex/1000

SR = Stitch rate/metre

FPH = Pile height above the backing X 2 / 1000

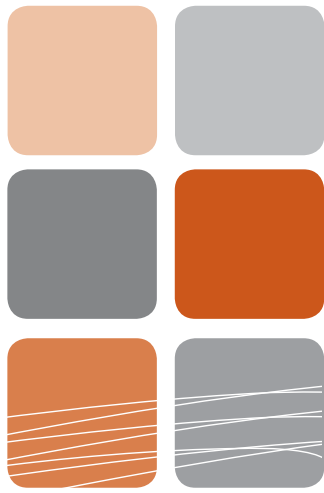
Top Tip:

Product specification sheets will sometimes nominate an acceptable variation of +/- 10% in the face weight of the delivered carpet. Given that -10% represents up to \$15,000 AUD in missing yarn on a hockey field sized area, it is wise to nominate a minimum face weight that has to be delivered and installed.

Top Tip:

Do sample testing (via an appropriate testing laboratory – Appendix 6) to check that the installed product meets specification. Assess the product delivered by taking samples from six different selected locations. Deductions should be made from payments for products that fail to achieve the accepted and agreed minimum product weight (face weight) on a direct pro-rata basis – or reject the product!

In addition to the carpet testing, you may wish to also test conformance to standards for seam strength (having already tested the thickness of the layers in the base the shockpad 'mix' etc).



1.5.4 Carpet Infills

General

The primary purposes of infill materials are to:

- Support the pile of the carpet (to help it remain vertical).
- Provide ballast (weight) to hold the carpet in place (over a sometimes moving base).
- Contribute to:
 - Player/surface interaction (such as underfoot grip) and the cushioning qualities of the surface
 - Ball/surface properties such as, bounce and roll.
- Transfer the loads imposed by players moving about the surface into the underlying base.

The grading, composition and depth of the infill materials are therefore carefully selected by the manufacturer to ensure the combination of the carpet pile and infill materials gives the type and level of performance required from the surface.

The most often used infills are sand (silica sand that is non-abrasive, non-staining, well rounded, dust-free and of uniform grading and density), water (still used on some hockey pitches for elite level competitions), and rubber granules (manufactured or recycled). Recycled granules are often made from recycled tyres, industrial waste rubber and running shoes.



Sand distribution

Rubber Infill

There are three key types of rubber infill:

(i) Recycled rubber

(described above)

- 0.5 – 2.0mm size most common.
- Least expensive, absorbs and radiates heat from sunlight and can raise field temperature to 20°C above air temperature, can give off an odour. Environmental impact still being reviewed. (See 1.16).

(ii) EPDM

(Ethylene Propylene Terpolymer)

- Virgin rubber and fillers
- Produced from sheets of rubber that are specifically manufactured for granulation.

- Good quality, relatively high price.
- Green-colour EPDM rubber is specially manufactured for sport, has better stability under UV radiation, and absorbs and radiates less heat from sunlight than SBR (re-cycled) rubber granules but is more expensive.

(iii) TPE

(Thermoplastic elastomers)

- Manufactured to suit, good quality control, but relatively expensive.

Note: Section 1.16 of this guide (Environmental and Health Issues) includes analysis of information regarding environmental concerns relating to recycled rubber granules.

Organic Infill

A developing alternative to rubber granule infill is the option of organic infill, such materials being of plant origin. Able to be recycled, these infill types are said to keep the median temperature of artificial grass pitches lower than that of pitches with rubber infill. At the time of publication, the first soccer pitch in Melbourne (Kingston Heath Reserve,

Cheltenham) featuring organic infill had just been completed.

Refer to section 1.17 (p54) 'Current Product Developments' for information related to several new developments with infill materials. These include rubber granules that come in colours other than black, and rubber granules that are coated with various compounds.

1.6 Playing Characteristics and Sporting Standards

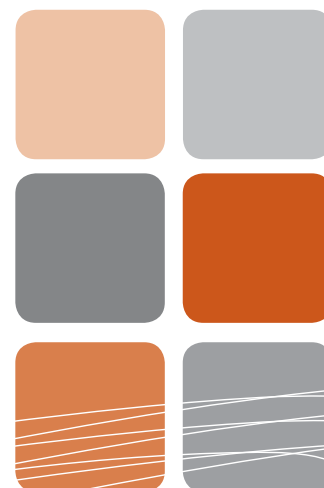
Each sport that utilises artificial grass has its own playing surface requirements, generally tightly defined by the sport's governing body. If an artificial grass sporting area is to be used for more than one sport (which may be necessary to ensure the financial viability of a facility or its full use), then compromises may be necessary to the choice of the most appropriate surface system and the performance.

Short, medium and long-pile, filled, dressed and unfilled systems are each suitable for a variety of sports, but currently no one carpet system is

suitable for all sports. Refer to Table 1, Section 1.7 – Suitability of Artificial Grass Surfaces for Sport.

When planning an artificial grass project, consult with the peak bodies of sports that are intrinsic to your project to ensure that important standards and specifications are met.

This section provides an overview of the requirements of sports in Australia and a range of resources and contacts that can be referenced to determine the artificial grass specifications for various sports.



Multi sport surface - Mill Park Secondary College

1.6.1 General

All materials, workmanship and procedures should comply with the relevant requirements of all current standards, codes of practice and

specifications promulgated by Standards Australia. Those that have relevance to synthetic sporting surfaces in Australia include:

Standard	Year	Topic
AS 3541.1	1988	Synthetic Sports Surfaces – Part 1 General Principles.
AS 2983	1988	Synthetic Sports Surfaces: Test Procedures Only.
AS 4693.8	2004	Surfaces for Sports Areas: Methods of Test Procedure for the preparation of synthetic turf and textile test pieces.

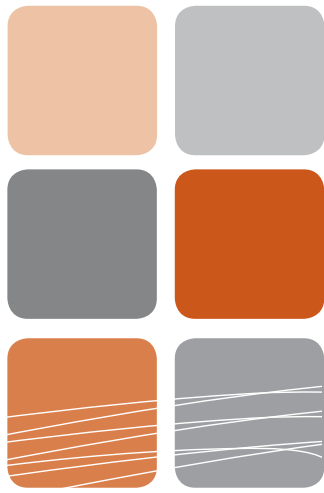
Note: There are no standards for the manufacture, design and installation of synthetic sporting surfaces in Australia for Australian conditions and sports. However, two key British Standards that relate to synthetic turf surfaces are:

Standard	Year	Topic
BS EN 15330-1	2007	Surfaces for Sports Areas – Synthetic Turf Surfaces Primarily Designed for Outdoor Use – Specifications for Synthetic Turf.
BS EN 15330-2	2008	Surfaces for Sports Areas – Needle-Punch Carpets Primarily Designed for Outdoor Use – Specifications for Needle-Punch Carpets.

Other British and European Standards relevant to synthetic grass can be found at: www.infostore.saiglobal.com

Top Tip

It is important that sporting clubs, schools and local government authorities are well-aware of the player insurance coverage for each sport as it relates to games/training conducted on artificial grass.



1.6.2 Soccer

After unsuccessful experimentation with shorter pile carpets in the 1980s, soccer has found its natural turf equivalent in recent years with third generation long-pile carpet (35-65mm), usually filled with a combination of sand and/or rubber granules.

Because of the difficulties that ground



Seymour Shaw Park, Sydney

owners have faced in growing and maintaining natural turf surfaces in many parts of the world, soccer authorities introduced artificial grass into the game's laws in 2004 (following the games being played on these surfaces at the FIFA U-17 World Championship in Finland late in 2003).

Locally, the governing body for football (soccer) in Victoria, Football Federation Victoria (FFV) has recognised the value of synthetic surfaces as a complement to natural turf, especially where there is a need for frequent use and where the maintenance of reliable surface standards is required. Nationally there have been W-League (women's national league) and National Youth League matches sanctioned by Football Federation Australia played on synthetic pitches. As yet no A-League matches have been played on synthetic pitches.

FFV has adopted FIFA requirements as the basis for approval of pitches for competition matches.

The aim of FIFA's standards is to replicate as closely as possible the playing characteristics of high-quality natural turf. To meet the FIFA-recommended endorsement level requires successful completion of both laboratory and field tests. There are two FIFA recommended quality levels:

- 1 Star for recreational, community and municipal use; and
- 2 Star for professional use.

FFV's competition rules require at least FIFA 1 Star specification for general competition and FIFA 2 Star for higher order competition (Men's Victorian Premier League).

FIFA has conducted a considerable amount of comparative testing to assess artificial grass pitches versus natural grass³ and key findings are:

- There are no significant differences in playing performance on artificial grass pitches versus top-quality natural grass.

- Based on play analysis: there is a similar time of ball in play, similar number of touches, similar passing success rate, etc.
- Players are more likely to perform ground tackles on natural turf.
- The number of fouls and yellow cards are higher on artificial surfaces.

The other key requirement relating to the use of synthetic surfaces for soccer is compliance with FIFA's 'Laws of the Game' under which competition matches are held. Law One – 'The Field of Play' sanctions the use of synthetic pitches and has a number of requirements particular to synthetic pitches, including the colour of the surface (which must be green) and the restriction of linemarkings to those required for soccer only (cited in the Interpretations section of the Laws). The linemarking provision applies to natural turf pitches as well. Under certain conditions FFV will allow limited extraneous linemarking on grounds used for junior matches. Temporary linemarking for other sports or variants of soccer can be a solution.

Top Tip:

Local councils, clubs and schools should also be aware that not only does the FFV's Rules of Competition specify the required size of fields for various levels of competition, the required safety run-offs, the necessary provision of ancillary features (including marked technical areas, fences, lighting, team benches) but it also stipulates minimum changeroom and toilet facilities which should be available on-site for matches to be allowed.

³ 'Prozone' studies - http://de.fifa.com/mm/documents/afdeveloping/pitchequip/case_study_technical_analysis_351.pdf

Recently in Europe, artificial carpets that utilise a beneath-the-carpet shock pad instead of, or as well as, rubber granule infill have been approved (at the time of publication the first such soccer installation – shock pad plus rubber granule infill – had been completed in Melbourne). This is a significant innovation from an Australian perspective because this type of soccer pitch is close in structure to the preferred model for Australian rules football, and therefore further highlights the potential for both sports to enjoy a shared sports field. (Refer to section 3.5 for important shock pad information).

Top Tip:

FIFA has recently upgraded their 'Quality Concept' accreditation process to include installed field sample testing and the mandatory acquisition of maintenance equipment and training. Refer www.fifa.com/aboutfifa/developing

Notes:

1. FFV provides a free advisory service related to the design and construction of both natural turf and artificial grass pitches.
2. Refer to the Bibliography (p123) for an extensive list of key resources.



Kingston Heath Reserve, Cheltenham



1.6.3 Rugby

Rugby Union

The International Rugby Board (IRB) has adopted performance standards (involving both laboratory testing and field testing) that define its interest in third generation long-pile carpets.

The key differences between soccer and rugby's specifications of artificial grass are:

(i) Rugby's specification or standard for artificial grass surfaces (refer below) is a developmental or temporary standard. Rugby authorities are clearly monitoring ongoing developments with artificial grass and are still seeking to satisfy themselves regarding suitability for the specific demands of their sport.

(ii) Until recently, the rugby specification ('developmental standard') called for the placement of a shock pad under a third generation carpet (it needs to pass head injury criterion), therefore rugby fields had both a shockpad plus rubber granule infill in the pile. The College Rifles Rugby Club in Auckland has received IRB approval for the world's first artificial grass rugby pitch that has no shockpad. On the performance of the surface system alone (carpet and infill), this field has been able to meet required IRB requirements for vertical deformation and critical fall height. Key resource documents related to rugby's interest in artificial grass fields are:

- UK Rugby Football Union and Football Association 'Artificial Grass Pitches for Rugby and Association Football' (2007).
- International Rugby Board 'Regulation 22 – Standard relating to the Use of Artificial Playing Surfaces' (2008) www.irb.com



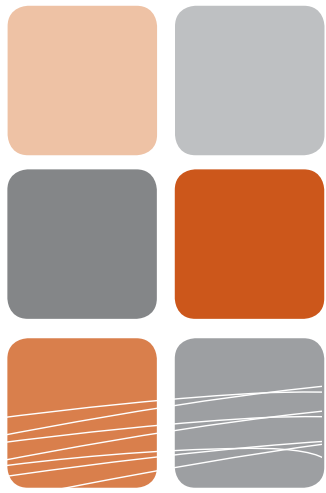
The Scrum

Rugby League

Rugby League is currently reviewing artificial playing surface specifications. The priority is for a non-abrasive product that reduces the risk of player field impact injuries. Refer to the 'Rugby' section in the Bibliography, for draft specifications currently being considered for adoption by Rugby League.

Touch Football

Touch Football is now being successfully played on 3G (rubber granule infill) fields. Touch Football Victoria advise that footwear selection is seen to be very important on artificial grass.



1.6.4 Australian Rules Football

In 2008 the Australian Football League (AFL) and Cricket Australia (CA) released a detailed specification⁴ that allows their sports to be played on artificial grass. By mid-2010 several products meeting that specification had been developed.

These products are typically sand-dressed polyethylene carpets nominally 40mm high, sitting on a 20mm pre-formed shockpad. They are dressed with rounded sand grains to approximately 20mm, leaving approximately 20mm of the fibre blades exposed.

The most significant difference between this carpet system and that now being used for soccer is that the Australian rules football/cricket version requires a shock pad (a key performance criteria for Australian football is the critical fall height for players), while the FIFA-approved surfaces have rubber granule infill rather than, or in addition to, a shock pad (note the reference in Section 1.6.2 to an Australian rules football-similar surface now being used in several soccer installations in Europe).

head injury) issue.

Artificial grass fields have been approved for use for all levels below the key state leagues around Australia (i.e. the Victorian Football League). Even the elite Under 18 TAC Cup can be played on artificial grass fields.

The AFL has confirmed that it is comfortable for fields to include permanent lines for other sporting codes. The AFL acknowledges the benefit to the community of multi-purpose fields.

Another important aspect of the introduction of artificial grass into the Australian rules football and cricket world is the AFL/CA's official licensing arrangement with three suppliers (at the time of publication). At the time of publication these were:

- TEAM Sports;
- Tiger Turf; and
- Sports Technology International.

This arrangement will not prevent other companies from competing for

Top Tip:

Single products that meet the needs of a number of different sports (ie. Australian rules football, cricket and soccer) will evolve in time, but organisations considering the installation of a multi-sport artificial grass pitch now must investigate whether there are limitations (fixturing, insurance, line marking, etc) placed on those multi-use/multi line-marked pitches by particular peak bodies.



Multi-purpose surface at Mill Park Secondary College (not AFL approved)

A key outcome of this difference in the impact-absorbency of the surface will be the capacity of the respective surfaces to cater for other sports. For example, AFL officials believe that the new, approved Australian rules football/cricket surface will meet soccer performance specifications, but that the soccer surface (without shock pad) fails the AFL/CA specification – particularly relating to the critical fall height (risk of

Australian rules football and cricket field installations, but only projects that use AFL/CA-approved synthetic turf products will be eligible for a proposed rebate/grant program from the AFL/CA.

At the time of going to print, the tender process had just begun for the first ever full-sized artificial grass Australian rules football oval, to be constructed at Point Cook in Melbourne (see p129).

⁴ 'Development of Standards for the Use of Artificial Turf for Australian Football and Cricket' (University of Ballarat – 2008).

1.6.5 Cricket

Artificial grass pitches have become the preferred playing surface for middle and lower grade cricket competitions over the past two decades. Replacing old matting and malthoid pitches, these pitches are generally single strips of high-density carpet (9 – 11mm pile height) glued to a concrete base. They have no infill. Pitches that are infilled with rubber granules over the winter period must be thoroughly cleaned out (repeated through cricket season) before summer use.

In comparison with those older types of pitches, the artificial grass version is low maintenance. During the winter season, the pitch is covered with loam or a second sheet of artificial grass (often a longer pile with much less density of fibres) is laid over the actual pitch, and the upper layer is filled with rubber granules to provide a cushioning level to counteract the pitch's concrete base.

In preparation for the new season, the upper layer of artificial grass is removed, and the uncovered pitch is vacuumed clean and sometimes water-blasted to ensure that contaminants are removed from the base of the playing surface.

In recent years a product has been marketed to local government authorities and clubs as both suitable for use as a cricket pitch and as a suitable surface during the winter season – without the need to be covered with loam. This is not a preferred surface from Cricket Victoria's perspective as the longer pile affects ball bounce and playability.⁵



Cricket pitch close up
Mill Park Secondary College

Top Tip:

The cricket pitch needs to be a specialist cricket pitch, not a 'marked-up' area of artificial grass carpet as used in the outfield.

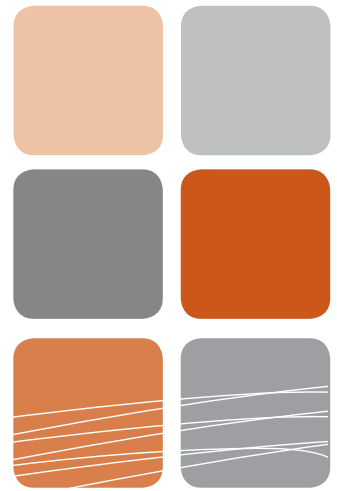
The AFL advises it is happy for artificial grass cricket wickets to be located within or adjacent to its playing fields provided an approved means of covering the pitch in winter is used.

In relation to cricket outfields, as is stated above in the Australian rules football section, (1.6.4) there has been a breakthrough in artificial grass technology, and a prototype surface has been approved as meeting the detailed Australian rules football/cricket outfield specification. Cricket Australia is satisfied that the potential problem of surface temperature during hot weather is one that is manageable (through their existing heat policies), as is the general all-round performance of the product specification for cricket at all levels. Cricket Australia believes the new specification is as close as is practical to the performance of natural grass, with excellent rebound and roll-ability of the ball across the surface area.

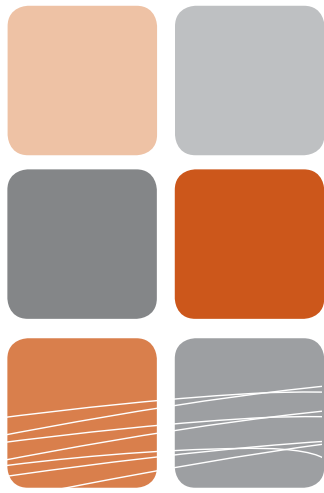
Top Tip:

Ensure that field managers, users, coaches and parents are aware of the potential for heat illness and to recognize the symptoms. Also be specifically aware of the relevant sporting association's heat policies.

Another important aspect of the introduction of artificial grass into Australian rules football/cricket is the AFL/CA licensing arrangement with a limited number of suppliers. While any company with a product that can meet the detailed specification will be able to bid for projects (through local government or other tender processes), in the case of AFL/cricket projects, only projects using products from the preferred suppliers will be eligible to seek financial grants towards project from the AFL/Cricket Australia funding program.



⁵ 'Comparison of the All Seasons and traditional synthetic surface'. (Victoria University 2010)



1.6.6 Hockey

Hockey was an early adopter of artificial grass. First tried for a major event at the 1976 Montreal Olympic Games, artificial grass soon became the preferred surface for all elite hockey events, and by the early 1990's artificial surfaces were becoming commonplace at local club level around the world.

The first artificial grass hockey pitches were similar to AstroTurf at the time – high-density, short-pile height, fairly stiff and abrasive nylon fibres. Hockey quickly moved to watering its elite level pitches to improve player comfort, safety and playability and favoured sand-filled artificial grass for local level hockey.

More recently, 'sand-filled' pitches have given way to 'sand-dressed' pitches (18-20mm fibres crimped down to 10-

13mm) filled with sand to somewhere between 50 to 80% of its pile height. 'Unfilled' pitches (10-12mm high, high-density low-friction carpets without infill material) that can be played on without having to be watered, are also being developed and installed.



Top Tip:

When replacing their worn field surface many hockey clubs are deciding to replace an existing sand-filled field with a sand-dressed model. While players call for this change (sand-dressed pitches immediately present improved playing characteristics due to the absence of sand close to the playing surface), administrators need to be aware of the following:

- Sand-dressed carpets generally cost \$30,000 - \$40,000 more than sand-filled carpets.
- Sand-filled carpets are lasting 10 – 15 years on average in Melbourne, whilst the likely lifespan of sand-dressed pitches is unknown.
- The absence of weight in the carpet ('sand-dressed' = 90 tonnes of sand, sandfilled = 220-300 tonnes) is an issue in areas with reactive clays.

Field Approval Categories

FIH (International Hockey Federation) field approval standards acknowledge:

- 'Global' level: International standard, unfilled, watered
- 'National' level: unfilled, filled or dressed (water not necessary).

Hockey on a third generation (3Gen) long pile turf?

3Gen pitches are rapidly coming on-stream in Victoria for Australian rules

football, cricket, soccer, rugby, etc, but English testing to date suggests that it is unlikely that carpets higher than 40mm would meet FIH standards. Of the 40mm 3Gen surface systems that have met FIH/England Hockey (EH) standards, these have only been sanctioned for lower level club and school usage. Hockey played on these surfaces will be slower, with sometimes unpredictable levels of consistency. The England Hockey policy is:

EH Category 1	Water based and sand dressed surfaces approved within the FIH Global/National parameters.
EH Category 2	Sand filled surfaces within the FIH National parameter.
EH Category 3	Long pile (3Gen) surfaces that are categorized by FIH as satisfying their 'National' performance parameter. The certification shall be based on on-site testing.

Top Tip:

FIH may follow FIFA's lead in increasing required performance standards under their FIH Assured Quality Pitch Supplier program. Civil works may have to be guaranteed (as well as the surface system), maintenance training provided, etc.

1.6.7 Tennis

The International Tennis Federation (ITF) recognises the use of synthetic grass playing surfaces and has used artificial surfaces since the 1970s. Tennis is one of the few international elite level sports that is played on many different surface types. The standards and properties of each surface are important when

development surfaces', they are widely used and promoted for community and club use. Many clubs and centres report the benefits of artificial surfaces to include increased memberships, revenue and court use, being softer on joints (especially for older players) and decreased maintenance and water

ITF Surface Code	Type	Description
B	Artificial Clay	Synthetic surface with the appearance of clay. 'Appearance' relates only to the form of the uppermost surface material and not other characteristics).
C	Artificial Grass	Synthetic surface with the appearance of natural grass. 'Appearance' relates only to the form of the uppermost surface material and not other characteristics.
E	Carpet	Textile or polymeric surface applied in rolls or sheets.



Sand filled, artificial grass tennis court

evaluating the quality of performance of the court and the level and ability of users.

The ITF provides three classifications for synthetic surfaces under their range of classified court surfaces (the first two of which are artificial grass surfaces⁶).

Tennis Australia's (TA) court surface policy only recognises three surfaces as player development surfaces. Surfaces are based on the existing Grand Slam surfaces (none of which are artificial grass surfaces), being; porous/clay, natural grass and hard court (including cushioned and non-cushioned acrylic variations). Tennis Australia player development requirements state that, 'surface type choice is made on the basis of characteristics including; soft on the body, ability to slide during point play and 'slow' in relation to ball response on the court surface'.

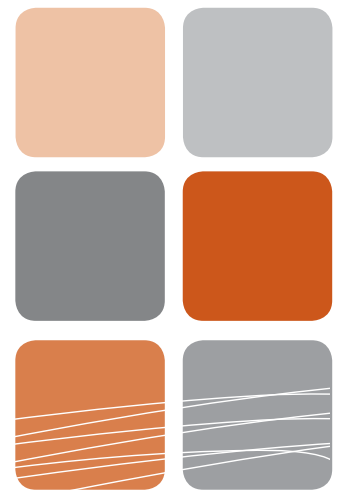
Despite artificial grass surfaces not being Tennis Australia 'supported player

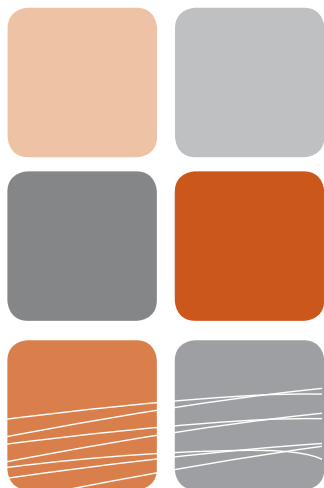
requirements and costs – all of which has significantly contributed to local club viability.

There has been an increasing trend in the use of artificial grass and artificial clay court surfaces in Victoria and across Australia at the community club level. The most common surface choices are Sand-Filled Artificial Grass (SFAG) and synthetic clay. Like surfaces for other sports, there are many products, varieties, colours, pile lengths and infill materials on the Australian market. Careful investigation and research of relevant products, suppliers and installers is recommended for any club, council or land owner wishing to install a synthetic surface.

Alternative hard court and acrylic surfaces (cushioned and non-cushioned) have also seen a resurgence across the Australian market, primarily influenced by the current TA court rebate funding

⁶ ITF Approved Tennis Balls and Classified Court Surfaces, International Tennis Federation, January 2009. Source: Tennis Australia, Facility Development and Management Framework for Australian Tennis, 2008





scheme, the installation of similar products for the Australian Open and through the conversion of more resource dependent surfaces such as red porous courts (particularly evident in metropolitan Melbourne).

Tennis Victoria's database (as at 2010) identified the following court surface provision breakdown for affiliated clubs across metropolitan Melbourne – red porous (48% of courts), synthetic grass and synthetic clay (30%), hard court (14%) and other or not-specified (8%).

Artificial and acrylic surfaces are generally constructed on concrete, asphalt or crushed rock (not acrylic) bases. The integrity of the surface is highly dependent on the quality of the base construction and detailed soil, ground stability, tree root invasion and drainage investigations should be carried out to inform the most appropriate pavement design and

construction methodology for each court development project.

Tennis Queensland's Technical Manual for the Design, Construction and Maintenance of Tennis Facilities provides a comprehensive guide to the development of tennis courts and associated infrastructure. The document is available at: www.tennis.com.au/qld

Tennis Victoria, in conjunction with Sport and Recreation Victoria, has developed a Tennis Facility Planning Guide promoting best practice in the planning and development of local tennis facilities. The guide is written for clubs and local councils and is available via: www.sport.vic.gov.au

1.6.8 Lawn Bowls

In response to the high costs involved with maintaining natural turf greens, lawn bowls began to look at synthetic greens some 30 years ago. Since that time there has been the evolution of both sand-filled and unfilled synthetic carpets.

Lawn bowls carpets can be either tufted, woven or needle-punched products. The characteristics of these products are:

- a) Sand-filled products
 - **Tufted** products are generally 13-15mm high, and usually made with a Knit-de-Knit fibre yarn which crimps down to 12-13mm, sometimes coming with a cushioned backing. They generally have approximately 8mm of sand infill. In composition and appearance they are similar to artificial grass used for hockey pitches, tennis courts and so on.
- b) Non sand-filled products
 - **Woven** carpets are much lower (generally about 4mm high, but sitting on an underlay to help control both comfort and green speed levels). These carpets are tensioned to achieve a consistent playing surface.
 - **Needle-punched** products are created by a process of converting batts or webs of loose fibres into a coherent nonwoven fabric on a needle loom. The product is generally 6-9mm high, and also has a 3-9mm underlay. The combined carpet and underlay will usually be in the 9-18mm range.

A key to the improvement of performance in Australia for these surfaces has been the significant improvement in base construction over the past decade. All of these surfaces are built over a porous, stable base (typically sand, gravel or scoria) with sub-surface drainage essential given the totally flat playing surface requirement.

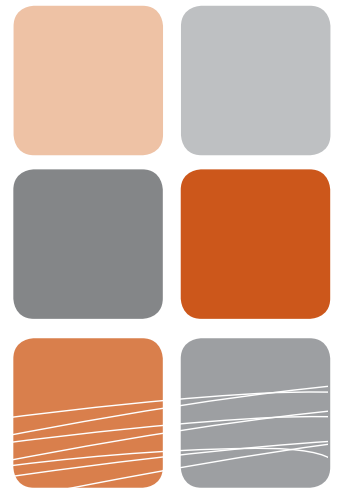
In such a traditional sport, some players are disappointed with the compromises that artificial grass greens can entail (faster green speed, excessive or uneven draw and reduced player comfort due to some surfaces being harder and hotter). But they do provide a guaranteed year-round playing opportunity, regardless of weather and overcome issues relating to grass growth, or natural turf wear and tear, while also benefitting fixtures and fund generation via year-round accessibility to greens.

Maintenance requirements for synthetic grass greens are much reduced in comparison with natural turf greens, mainly revolving around keeping the surface dirt and dust free, which, if unchecked, can lead to the surface becoming hard and fast and the natural drainage through the surface system getting clogged and slowing down.

In Section 6.5 of this guide - Maintenance of Artificial Grass Lawn Bowling Greens - information is provided about the maintenance of tufted, woven and needle-punch surfaces.



Artificial grass bowling green



1.6.9 Baseball

A full synthetic turf baseball field (third generation, long-pile with rubber granule infill) opened in Geelong, Victoria, in 2007. Using artificial grass for the infield, outfield and the running paths between bases, with a small section of en-tout-cas adjacent to each base to allow the base runner to slide in if necessary. There is no natural grass on this field.

Baseball Victoria advise that the major advance that the Geelong facility has over the partly-synthetic carpeted State Baseball Centre at Altona is the use of third generation long-pile artificial grass which now allows players to fully use their metal-cleated baseball shoes – thereby enhancing their stability and safety.



Geelong Baseball Centre

1.6.10 Golf

Synthetic grass is now used at some golf courses for driving range tees and, in some cases, actual tees, greens and fairways. It is also used for similar purposes in private installations and in commercial indoor facilities. The Reef Palm Golf Course at the Zilzie Bay Great

Barrier Reef Resort near Rockhampton, Queensland, combines a system of synthetic greens, tees and fringes with Keppel couch fairways. Internationally there are a number of golf courses with artificial grass fairways.

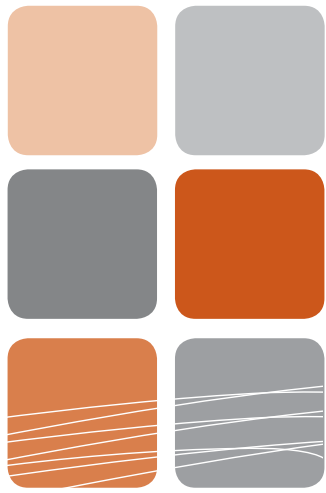
1.6.11 Lacrosse

National level by-laws encourage the use of artificial grass for elite level competition. For such competition Lacrosse Victoria advise that wet, sand-dressed and long-pile surfaces are all preferred ahead of sand-filled surfaces.

Internationally, a high percentage of women's and men's collegiate games in North America are played on artificial grass.



Australian Lacrosse team – Footscray Hockey Centre



1.6.12 School Sports

There is a wide variety of artificial grass installations in Victorian schools, ranging from playground surfacing through to international-standard sporting field provision.

The majority of installations in Victorian schools involve medium-pile sand-filled pitches that are designed for sports such as hockey, tennis, netball, basketball (and other suitable sports) where a harder, ball rebounding surface is required.

Some schools are now adding third generation pitches (long-pile, sand and/or rubber infill) to allow soccer, rugby, and Australian rules football to be played on a surface with more 'give' for falling players. There are many examples of schools installing artificial grass running tracks around new artificial grass play spaces, and these

are proving to be popular for use during physical education and sport classes, and for before and after school fitness programs.

Existing installations in school settings are providing a more serviceable space than previous grass and bitumen activity areas, and there is anecdotal evidence that artificial grass play areas (although hotter than natural grass at times) are cooler and less injury prone than the bitumen areas that they often replace.

Schools, councils and clubs need to be mindful that many multi-use school surfaces are not constructed to sport specifications and therefore cannot be used for formal sporting competition (although they may be used for training).

Check section 3.14 (p. 77) for further information on small games areas.

Top Tip

Before planning for future income from sporting usage of your school's artificial grass area, check with the relevant sports as to their design criteria, i.e. minimum size, line-marking restrictions, other specification requirements.



Monmia Primary School, Keilor Downs

Top Tip

When planning your facility, ensure that you speak to other schools that have had artificial grass installed. Review both new and older installations. When deciding on a supplier, ensure that you check relevant project experience and the quality of the proposed materials.

Top Tip

Lots of lines mean extra potential for seam failure as time goes by. Balance the need for permanently installed lines with a general view that over-doing lines could be problematic down the track.