Artificial Grass For Sport

Part 4 of 8

2.1: Introduction

The construction of a new sporting facility from initiation through to completion is a long and involved process. Although there is a lot of good documentation available that presents project planning from an engineering or project management point of view, the process outlined here emphasises even greater effort being exerted at the early investigation and forward-planning phases. This is a detailed planning process and is geared towards larger scale projects, but a similar process (although less extensive) is also advocated for smaller projects.

Victorian State Netball and Hockey Centre

Men's Lacrosse

2.2: Leisure Facility Planning Process

Figure 2: The Leisure Facility Planning Process

1. Project initiation
1.1 Establishment of the Project Steering Committee

2. Feasibility
2.1 Literature review
2.2 Market analysis
- Demographic analysis of catchment zone
- Inventory of existing like facilities
- Needs assessment/demand analysis
- Reviewing/interpreting relevant trends
- Identifying/evaluating development opportunities

2.3 Draft Management Planning/Schematic Design Planning

Draft Management Plan

- Broad policy statements ie. aim of the facility
- broad objectives
  - type/range of user desired
  - degree of community input
  - financial goals: profit/breakeven/ 'controlled' subsidy
  - access for disadvantaged groups
- draft user group summary
- draft program listing/schedule

Schematic Design Planning

The point at which some conceptual design can begin

- management option analysis
- staffing requirements
- draft marketing/promotion strategies
- budget projections
- methods of evaluation

- listing of required facility components
- location/site options
- conceptual design layout
- schematic design options
- construction cost estimation

Note: the feedback loop that is operating between the almost concurrent 'Draft Management Planning' and 'Schematic Design Development' aspects of the project.

Decision Point: Whether to Proceed to Project Refinement

3. Project refinement

Refined Management/Business Planning

- user/usage projections
- programming schedules
- specific promotional strategies
- staffing structures (job descriptions, lines of authority, etc)
- management structure
- risk analysis, etc

Detailed Design Development

And other items:

-Detailed construction costing
-Considerations re: funding sources
-Considerations re: 'staging' the development
-Development time frame

2.3 Explanatory Notes

Introduction

The numbering of items for the following 'explanatory notes' corresponds with the numbering shown in 'Figure 2' (p57) 'The Leisure Facility Planning Process'.

Item 1.1 Establishing the Project Steering Committee

Facility development projects with good design, usage and management outcomes are generally characterised by the guidance of skilled, diverse project steering committees. Good facility planning and design requires expertise over a range of skills and disciplines (refer to table below).

As has been emphasised in Section 1.15 (Professional Support) for large and medium sized projects, it is suggested that there are significant benefits in bringing experienced, proven artificial grass project expertise onto a project steering committee.

Particularly where the club representatives, council officers, school council representatives or staff are relatively inexperienced with this type of project, the group will not want to be left unsupported in its attempts to review the offerings of the artificial grass suppliers/industry, the usage of the civil contractors, and the crucial workmanship of the shock pad and artificial grass carpet layers.

An example of the make-up of the Project Steering Committee is listed below:

Engineering/project management	Team co-ordination, council liaison, co-ordination of the 'brief', control of consultancies, etc
Architectural	Design detailing, cost advice, etc.
Recreational planning	Market analysis, community liaison, etc
Facility management/design, etc.	Draft management planning, design input.
Existing operators/users	Experienced voices re: design, usage, and management.
Parent body support	Some sporting bodies have in-house expertise in facility related project development
State Government Sport and Recreation offices	Have available expertise/resources from many previous similar projects
Funding body representative	Generally a funding requirement

Table 7 - Sample Project Steering Committee

Item 2.1 Literature Review

This involves review of any previous documentation that might aid the planning of the new facility.

Item 2.2 Market Analysis

The components of a market analysis study can vary slightly depending on the project at hand, but some of the basic areas needing to be covered include:

Demographic analysis of the catchment zone.

This information is often readily available from the local council. Issues to consider are particular community characteristics that might affect the location, programming, marketing, management style, etc of the facility being planned.

Inventory of existing artificial grass pitches, courts, fields etc.

What is already available locally, and in the region generally?

Needs assessment (i.e. community surveys, demand analysis, etc).

Community involvement in the market analysis is essential both for the information that will be received and also for the interest and ownership of the scheme that this process generates. While professionals involved in the project's development might have strong hunches as to the community's needs, it is important to ensure we understand the range of community opinions. As well as creating a sense of involvement, this consultation might uncover some interesting ideas or an interaction that will improve the project planning.

Reviewing/interpreting relevant trends.
The market analysis needs to include a review of relevant trends in terms of participation patterns, as well as trends in like facility design and development.

Identifying/evaluating development opportunities.
This phase may also incorporate some preliminary location and site analysis. It is, combined with the draft management planning exercise, one of the keys to good feasibility study work.

Item 2.3 Draft Management Planning and Schematic Design Development

As is shown in Figure 2 (page 57) it is vital to develop an interaction between the management planning and schematic design planning areas of a project.

For many projects only a single project steering committee exists, so the requirement is to ensure:

- Expertise in facility management and facility design represented.
- Development of a relationship that allows constant interplay between these disciplines. Only then can a 'design for operational efficiency' be acheived.

If your project has separate working parties for: a) draft management planning and b) schematic design, ensure the active working of a feedback loop (refer to figure 2, page 57) between the two groups.

There are two key elements to keep in mind with this structure:

- The preliminary draft management planning exercise should proceed first that is the development of some broad policy statements, some draft user group analysis and some draft programming schedules.
- Only then should an architect or draftsmen be allowed to begin doing any preliminary drawing. Producing concept drawings earlier in the process tends to lock in people's thinking to a particular design rather than pursuing the development of the absolutely best possible brief that will guide the design process.

At the completion of the draft management planning tasks the following should be known:

- Policy statements to guide the general planning for the facility.
- Who the facility is being designed for.
- What programs will be provided for the users.
- The physical spaces and preferred surface type required to be able to conduct the programs.

For the detailed analysis of potential sites for a facility, and the location of the facility at the site, see Section 3.1(Site and Location Analysis).

Item 3.0 Refined Management Planning and Detailed Design Development

At this point those planning the project are aware of the type of facility that their client and/or community wants, have a reasonable estimate of its capital cost, preferred locations and the likely budgetary position of the facility for its first few years of operation. They are well placed to determine whether the project should proceed to its next stage of development.

Should the project proceed, a strong feedback loop again needs to operate between those working on the detailed management planning and the detailed design development.

3.1 Site and Location Analysis

3.1.1 Site Selection

The greatest risks and uncertainty arise from site ground conditions, so although selecting the best possible site for a sporting facility can sometimes be a complex task, it is always a vitally important task. Residential amenity, access, land stability, availability of services, etc, are just some of the factors that will affect the suitability of the site, and the cost to develop it.

Selection criteria include:

- Siting within or adjacent to school grounds can significantly enhance the daytime use of the facility.
- Siting within a sporting facility precinct can both reduce costs through the utilisation of existing resources within the reserve (i.e. pavilions, car parks).
- For facilities such as a shared, multi-use artificial grass pitch, choosing a site that is independent of particular clubs can enhance access and allow for alternative and/or more suitable management options.
- Relatively flat land can help reduce construction complexity and cost. On a flat site it is easier to remove topsoil and find solid ground. Natural ground is usually stronger than fill (when the soil is undisturbed) as a base for an artificial grass sporting facility.
- Sheltered locations away from exposed terrain can be advantageous (watch for significant over-shadowing which can lead to algae growth due to constantly moist conditions being maintained).
- Avoid sites closely surrounded by trees due to the potential long-term problems of invasive roots, and of surface moss caused by overhanging branches and leaf litter.
- Proximity to public transport.
- Adequate room for a fully dimensioned facility, including desired run-off allowances.
- Space for future expansion.
- Access for construction and maintenance plant or machinery (and storage of plant and pitch furniture).
- Seek sites where service installation (electricity, drainage, etc) will not be prohibitively expensive.

3.1.2 Locating the Facility on the Preferred Site

Factors that need to be taken into account include:

- Ease of access for players, spectators, maintenance and emergency vehicles.
- Proximity to the pavilion and support facilities.
- Location of the facility so that necessary floodlighting will not lead to planning restrictions because of residential amenity issues.
- Orientate the pitch so that ideally it is north-south facing to avoid low sun glare.
- The location must be accessible via a suitable, well-lit pathway(s) running between the site entrance, the changerooms and the car parking area. Well located pathways are essential to avoiding dirt being carried onto the playing surface via players' footwear.

3.1.3 Engineering Investigations of the Site and Location

Design and construction costs are obviously more expensive for sites with difficult ground conditions, so every effort must be made to avoid such sites (if possible) or at least to fully understand the site so that appropriate facility substrate design or ground stabilising works can be undertaken. This investigation phase can require some expense (typically up to 1% of the project cost in some cases), but can greatly reduce the risk of unforseen problems (such as increased costs).

It is critical in this early stage that sufficient resources be allocated to site and location research so a thorough investigation of levels, geotechnical conditions (the nature of the sub-soil with regard to load-bearing capacity, porosity, summer and winter water table levels and liability to movement), and the locating of underground services (gas, electricity, water, etc) can be determined.

The designer also requires knowledge of the weights and types of plant to be used at the facility during construction or subsequent maintenance (i.e. floodlighting). From all of this accumulated information the designer can determine the required depth and type of base, drainage system, porosity resolution, etc. It also enables far more accurate project costing to be determined.

Top Tip

Utilise a qualified and experienced engineer to both commission the site investigation and also design the facility. If a contractor is to undertake this role, make sure that the 'terms of contract' is clear on required site investigation and analysis.

3.2 Statutory Planning Issues

Statutory planning issues need consideration early in the process. Planning permission may be required for the installation of a artificial grass sporting facility, fencing and floodlighting. It is therefore recommended that the planning department at your local council be approached early to discuss broad siting and orientation issues, but also items such as:

- Fencing: design, height, colour.
- Floodlight poles: design, height, number, location.
- Floodlights: number; luminous intensity; light spread, glare and spillage outside of the playing area.
- Use: intended hours of operation.
- Noise: Expected increase in noise generation.
- Vehicle movement: onto or off the premises.

Potential means of addressing planning issues include:

- Floodlighting poles: can be painted to match surrounds, height can be increased or reduced, tree lines can be planted.
- Floodlight spillage: to lessen the impact of glare and light spill more specific lighting can be selected, as well as having fittings more specifically targeted to a pitch or court through the attachment of baffles to the fittings.
- Noise: evening sporting activities (community level) particularly in winter, attract few spectators. Regardless of this, a sensible time will need to be negotiated for 'lights out'.
- Security of the facility. Supervision should reduce excessive noise and 'out of hours' usage.

3.3 Preferred Form of Construction (Sub-Base, Base)

Utilising all of the information collected in the review of previous drawings and reports pertaining to the site, plus the data from new investigations (topographical survey, geotechnical report, drainage studies, etc), the designer is able to determine their recommended form of construction from sub-base level up to and including any carpet and infill (refer Section 1.1 – Indicative Construction Profiles).

3.3.1 Baseworks Criteria

For outcomes such as longevity and serviceability (drainage performance, etc.) it can be said that base construction is as much a part of the total surface system as the surface material and underlay. Based on good geo-technical advice, the sub-grade and the base-course beneath an artificial grass sports area should be capable of the following:

- Supporting the loads of all vehicles, plant, machines and materials to be used in the construction (without any excessive deformation being caused).
- Supporting the loads on the playing surface from players and maintenance equipment (without causing any long-term deformation of the surface).
- Providing protection to the surface from the effects of ground water and sub-grade movement.
- Ensuring that the water (rain water or neutral groundwater) drains away freely either into the subsoil or a drainage collection system.
- Providing porosity and/or run-off through heavy rain, ensuring that the playing surface will not hold standing water for any length of time (often a risk versus cost issue).

Top Tip

An essential preparation for basework design and construction is the undertaking of a thorough geotechnical investigation i.e. the testing of the site soils to determine the types of soil and their variability, the soil strength, composition, water content, potential for drainage and its potential for shrinkage/swelling through drying/wetting and other important characteristics. This early site evaluation stage is an essential part of a proper earthwork/ foundation design.

Graphic supplied by SAPCA - © SAPCA.org.uk

3.3.2 Construction Techniques

The methods and materials used for sports surface base construction are similar to road construction, with the exception of more detailed drainage design for the porous surface systems. In general, depending on the type and strength of the natural soils at the site (the 'sub-grade'), a sub-base is added to support construction plant and provide frost resistance, and then the upper layer is added which is typically either:

Bound:

- Mineral aggregates bound by spraying with a binder (bitumen emulsion or tar) after laying. Sometimes called semi-bound.
- Mineral aggregates (rubber, occasionally cork and polyurethane foam) bound by polyurethane binders. Usually 35mm to 50mm thick. Adds shock absorption to the construction.
- One or two layers of mineral aggregate pre-mixed with a binder (bitumen, tar). Normally a two-layer system in between 55mm and 85mm thick.

Unbound:

- Mineral aggregates (crushed rock, gravel, sand, lava or a mixture of these with rubber). May have a geotextile membrane above and/or below it. The selection of grade of stone and the degree of compaction will have a significant effect on the eventual playing characteristics of the surface.

Top Tip

A bituminous bound base is often called an engineered base, and an unbound base is often termed a 'dynamic' base. These terms can be confusing as both need to be 'engineered' i.e. designed properly. A bituminous bound base is harder than an unbound base, but will not move in the long-term, whereas an unbound base may need to be rolled and regraded during replacement of worn surface carpet systems.

The construction methodology is generally:

- Excavate down to a firm, load-bearing strata.
- Identify and replace any 'soft spots' with hard, non-degrading filling.
- Install drainage, either beneath the pitch or around it. If installing beneath the pitch, back-filling of trenches must be thorough so as to avoid subsidence and difficult or expensive rectifications.

- Lay and compact the sub-base. Normally a crushed stone, but can be re-cycled material, i.e. a clean crushed brick or crushed concrete. Normally between 150mm and 225mm in depth (Note: Special arrangements may be necessary with softer or more plastic clay sub grades).

In such cases the sub-base may need to be designed to minimise the effects of movement of the sub-grade due to seasonal changes in moisture content in the clay.

Unbound versus bound:
Unbound bases tend to be cheaper than bound surfaces and more yielding. Their disadvantage is their lower standard of dimensional stability (remembering that the greatest risk of pavement failure is movement of the sub-grade due to seasonal variation). Unbound bases demand very good site control and quality assurance to ensure good long-term behaviour.

Top Tip

Bituminous 'prime' spray seals come in many varieties/standards. Ensure that you know exactly what you are getting, and ensure (via this being a designated witness/hold point) that you get what you are paying for – see 1.13.1.4 and 1.13.1.5 for advice re: checking work undertaken.

3.4 Artificial Grass Selection

3.4.1 Role of a Sport Surface

In general, sport surfaces need to deliver three key outcomes:

- To provide safe provision of player movement, player interaction and ball interaction – at an appropriate level of performance to the level of activity or competition required.
- To maintain their performance to an acceptable level with regard to use, climatic effects, and over an appropriate period.
- To be cost effective (including maintenance costs) and manageable.

The tests conducted to check for player-surface interaction measure factors such as hardness, traction and friction, while for ball-surface performance, characteristics such as bounce, roll and spin are measured. These test data must conform to the published sports standards for a specific sport or for multi-use (refer Section 1.6).

3.4.2 Choosing the Surface

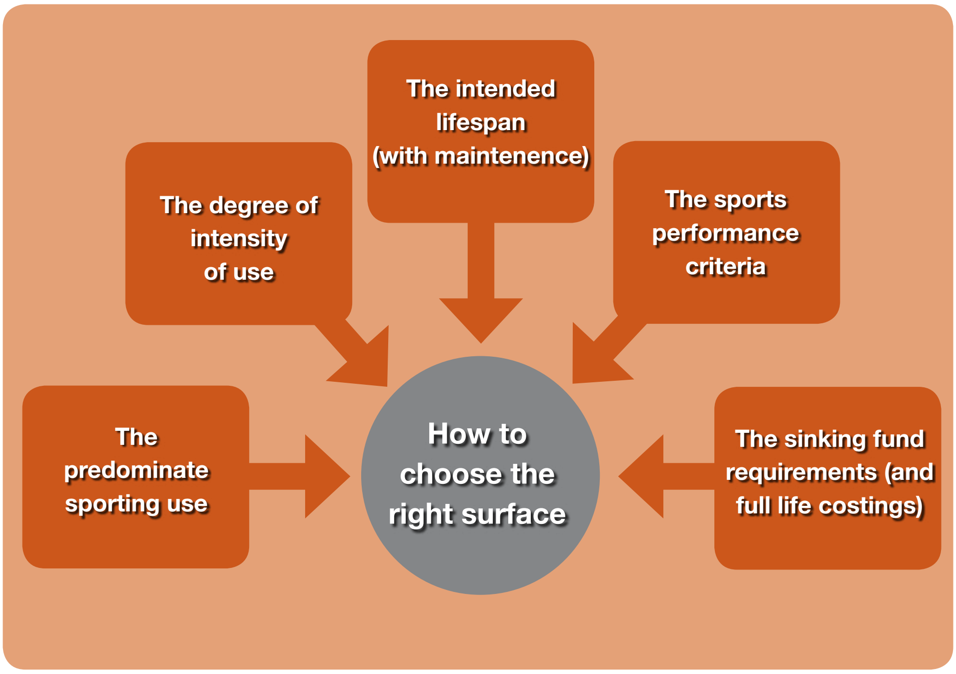

Figure 3: Choosing The Surface
Graphic supplied by SAPCA - © SAPCA.org.uk

Some of the key factors to consider when choosing the best surface are:

- What will be the predominant sporting use(s)?
- What level of performance is anticipated (i.e. international level competition, community level)?
- What is the expected level of intensity of use?
- Assuming appropriate maintenance is carried out, what is the desired lifespan of the surface system?
- From the business plan (in particular the lifecycle costing exercise – see Sections 1.10) what standard of facility can you afford to build, operate, amortise? For example, do you need a likely lifespan or income generating period of 12-15 years from a sand-filled carpet, or can you afford the slightly more player-friendly sand-dressed pitch which may only last eight years?

And once the type of carpet is determined, consider the following in regard to specific products or suppliers:

- Does the product have a license issued by the governing body, relevant for use at the level required for the project (eg. FIFA 1 Star, FIFA 2 Star, FIH Global, AFL/Cricket Australia).
- Has the supplier installed this type of surface in Australian or similar climates before? (Perform reference checks re: the product and the installer).
- Do the specific staff who are undertaking the installation have appropriate experience?

Top Tip

Have the contractor supply the above-mentioned information at the tender stage.

3.4.3 Artificial Grass Types

Section 1.5 of this guide provides a clear description of the types of artificial grass that are produced for sport, and the infill products that can be used. The table at Appendix 8 provides a good visual presentation of the different artificial grass types.

3.4.4 Seam Jointing

Proper initial jointing and the speedy repair of subsequent problem areas are imperative to maximising the lifespan of a facility. Undetected or poorly treated seam failure has been known to end the useful life of an artificial grass surface well before the lifespan of the carpet system should have lapsed.

Jointing occurs where two rolls of carpet (usually between 3.66m and 4.5m wide each) are joined on site, by using a backing tape (approximately 300mm wide) underneath the butted joins of two adjacent carpet strips. Both edges are glued to the backing tape to form a continuous seam, which generally must cross the width of the field. Note: The stitching of seams is still undertaken with some products overseas, but is rarely undertaken in Australia.

Seam trimming and gluing

Obtaining the maximum possible joint strength is essential, so best practice methods must be observed through this phase of work. Key elements include:

- The selected jointing tape must be high-quality and wide (minimum 300mm for seams, wider for line insertions).
- The tapes must be laid so the seams or inserted lines join centrally along the tape. Joint integrity is compromised if one of the carpet edges is fixed to less than 50% of the backing tape.
- The application of adequate pressure to the bonded seam while the curing of the adhesive takes place.

Be aware of problems that can or will occur applying adhesives in adverse weather conditions, for example wind, rain, humidity and impacted drying capacity (some high-quality two-pack polyurethane glues require dry conditions for best use – in the atmosphere and on the materials used – to form strong bonds).

Note: Joint seam strength is included in many sport ‘standards’ for artificial grass surfaces as a test for product acceptability.

Top Tip

Tolerance levels related to the join between two rolls of carpet are important to final appearance and performance of the finished system. Leading companies offer clients detailed documented standards in this area.

Top Tip

Weather can be a key influence on seam quality. Ensure that you ask up-front about all of the adhesives that are going to be used on your project. Some adhesives (specialised, very expensive) can be utilised in wet conditions, while others require absolutely dry conditions. Understand which are being used on your project, and when, and monitor very closely that dry weather glues are not being applied in moist/damp conditions .

Top Tip

Each of the sports has certain areas on their courts/fields where greater activity, and therefore greater wear and tear, occurs. Enquire as to whether the field/court linemarking at that point of the field/court can be produced within the middle of a carpet role so that a seam-free zone can be created in the high-use area. This has been done effectively at the top of the goal-scoring circle in hockey (by some companies).

The issue of what glues are used, and how they are used, are also vital ingredients in joint strength. As an example, the first few sand-dressed hockey pitches installed in Victoria have exhibited minor seam failure in key areas within two years of installation.

In response to this, installers have changed from using latex glues to more expensive, but much more effective two part polyurethane glues.

When considering artificial grass systems, ask questions of potential suppliers related to their exact gluing processes:

- What types of glues do they use?
- Where do they use these glues (some installers use polyurethane glues around the high-use areas, but cheaper glues elsewhere)?
- Understand how each surfacing option being considered works:
  - Is the carpet connected to the shock pad? And if so, how?
  - What is a loose-laid system?
  - At the seams (generally 3.6m apart), what gluing method is used between the pad and the carpet?
  - What is the impact of this gluing method on the ability to remove a carpet at the end of its useful life, and re-use the shock pad?
  - What is their policy regarding installing their product in various weather conditions?

Top Tip

Did you know that rolls of carpet need to be rolled out flat for a minimum period of time before installation? This is done so that flattened or twisted sections (flattened in the rolling/transporting process) can regain proper shape before installation begins.

Top Tip

As well as ensuring that the right glues/backing tapes are being used, it is equally important in determining ultimate seam quality that you select an installer with proven performance technique/methodology. The best guide to this is to check bidding companies previous work (particularly their oldest installations), and also the length of their installation (workmanship) guarantee.

Top Tip

In extreme cases, seam failure can end the life of a carpet system well before the use-by date of the product is reached. Put a lot of planning time into determining which glues, and which seam jointing processes are best for your project's long-term lifespan. Also check the potential installer's record over a long period in terms of seam performance: How many of these surfaces have they installed over how many years? Does the surface manufacturer endorse and support this company's seaming methods and materials?

3.5 Shock pads

An excellent description of shock pad options and quality is provided in the publication 'Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches' prepared by the UK-based 'Sports and Play Construction Association' (SAPCA)[18] which states:

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

3.5.1 Pre-formed Construction

Pre-formed rubber pads or rolls

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

Flat rolls generally have a thickness in the range of 3-15mm.

Carefully consider 'dimpled' (egg box type structure) pads. Experience shows that horizontal carpet movements relative to the shockpad are more likely with this system, causing rucks or tears, unless steps are taken to anchor both the shock pad and carpet.

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

Rolls of shock pad may be laid perpendicular or parallel to the subsequent rolls of artificial grass carpet (perpendicular is more likely to remove any coincidence of joints in the carpet and shockpad occurring). Whichever arrangement is used, it is important that all rolls should be laid straight and true with the minimum of distortion. Head joints (i.e. joints at roll ends, not sides) should be staggered by at least 1.0m across the surface. Prior to head jointing, each roll should be allowed to reach its optimum length before trimming. No joints should have a variance in height greater than 2mm. All joints should be seamed and taped to prevent gaps appearing from movement of the rolls.

Other pre-formed materials

Several other forms of proprietary shock pad are manufactured, marketed and installed by contractors, all with their own individual properties and requirements for laying. These include pads of closed cell foam; nylon filament; needle-punched, expanded polyethylene or vertical fibre systems (some of which are combined with rubber granulate) pads which are an integral part of the carpet system; various designs of prefabricated mat and tile and so on. Careful evaluation of pre-fabricated systems and laying processes is essential when making comparisons between products. Experience has shown that carpet and shock pad movements are more likely if the shock pad is not fully jointed or is not dimensionally stable.

Top Tip

'Integral' pads are bonded at the factory to the back of the carpet. Although capable of lasting longer than a carpet, integral pads unfortunately are lost when the carpet is worn out and removed.

[18] 'The Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches' The Sports and Play Construction Association (2009)

3.5.2 In-Situ Construction

Shock pads constructed in-situ normally vary in thickness from 10mm to 35mm and consist of a polyurethane binder mixed with rubber crumb or shred. The thicker pads may also contain pea gravel or other small aggregates. The mix design of the rubber particle shape, size and grading, and the binder type and content create the desired properties of the combined system once installed and cured (i.e. binder setting).

The precise specification and laying technique will vary depending on the installer and the priority sport. As with preformed pads, no joint should vary in height by more than 2mm and the completed mat should comply with the level of tolerance required of the finished installation. Samples should be taken for conformity with the specified density and tensile strength. Tensile strength has been shown to be a useful test for indicating expected durability (inadequate binder in the mix or variation in size range will affect the quality of the durability of the system).

Insitu Pad - Photo© Loughborough University; http://sportsurf.lboro.ac.uk

Top Tip

Whichever shock pad system is to be installed, a reference sample should be obtained at tender negotiating stage so that the installed shock pad can be checked for consistency of material.
Carefully monitored procedures and quality control checks should be in place to ensure that any variations in thickness of an in-situ laid pad do not affect the playing performance and compliance with the reference sample.

3.5.3. Other Shock Pad 'Issues'

Long-pile artificial grass fields (used for soccer, rugby, etc) usually use an infill in the carpet (rubber granules with or without sand granules) rather than, or in addition to, a conventional shock pad beneath the carpet. Because of the potential of infill materials compacting over time, disciplined attention to required maintenance regimes is essential in delaying this potential outcome. Note: Information is presented on the Sportsurf website http://sportsurf.lboro.ac.uk by ISA sport on long-term hardening of soccer fields (this is the subject of on-going research and development).

'Shared' surfaces such as the successful hockey/tennis model often found in school installations are an example of the need for compromises in design. Although hockey pitches generally incorporate a 15mm pad under the carpet surface, a tennis court would normally have no shock pad at all. The compromise 5-8mm pad is the usual 'compromise' that best provides a surface that is close to the preferred playing characteristics for each of the sports.

Pre-fabricated shock pads have been known to shrink over time. Some hockey fields have been known to have developed a gap every metre or so (the width of the roll/row of rubber tiles running across the ground) there is a gap in the shockpad of 5mm or more due to pad contraction. Where this has happened, the carpet has sunken slightly and has been filled to playing level with sand – potentially affecting ball roll and player footing. Questions to consider asking artificial grass manufacturers and installers include: "What were these 'shrinking' pads made of? Has the composition of the pads changed since then? How long will the pad size or stability be guaranteed for?"

Implications for future surface replacement: The immediate decision of pad selection or installation also affects choices that will be made when the surface needs to be replaced or refurbished. The option of being able to re-use a prefabricated pad is attractive, but needs to be considered in the light of either of the issues raised above. An in-situ pad should last two carpet lifetimes, but can be damaged, especially at the glued seam locations, by machinery removing the old carpet. Integral shockpads that form part of the carpet manufacture have to be disposed of with the carpet and are most costly long-term for this reason.


Evidence of shrunken shock pads

Top Tip

With in-situ shock pads, the rough texture of the pad helps grip the underside of the synthetic turf carpet, minimising the risk of carpet creep or movement. Where carpet creep is a potential danger, responses could include ribbon bonding, anchoring or other means of carpet retention.

Top Tip

The advantages of shock pads laid in-situ include the lack of movable joints, and the ability to 'smooth out' or correct small irregularities in the planarity of the stone or bituminous base. Disadvantages include a dependency on workmanship and weather conditions at the time of installation. Large irregularities will mean a variation in shockpad thickness and this affects the test results for player surface behaviour – more than ball behaviour.

Binder content: Shock pads are manufactured (in a factory or on-site) from a mixture of rubber granules and a polyurethane binder (effectively a glue). The percentage of binder applied has a substantial impact on the tensile strength of the resultant pad. See the chart below.

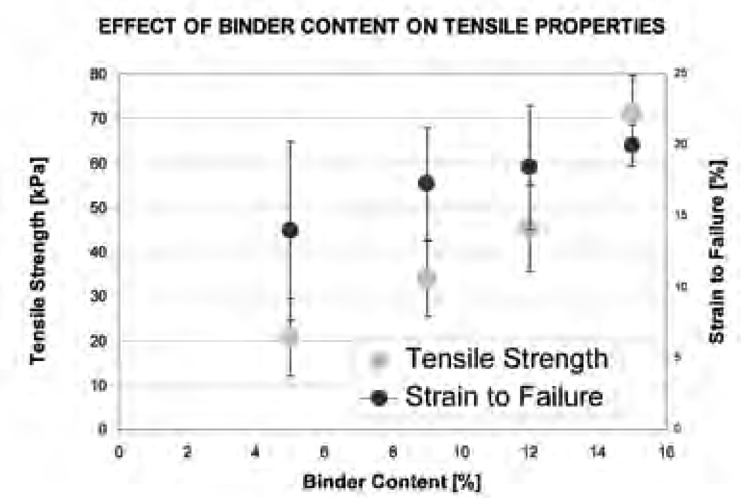

Figure 4: Effect of Binder Content on Tensile Properties
© Loughborough University; http://sportsurf.lboro.ac.uk

3.6 Drainage and Flooding Issues

Artificial grass sporting area constructions should always allow for the rapid drainage of water from the surface by either:

- Vertical drainage: A permeable construction that allows water to flow through the surface at a minimum rate of 100mm/hour into a drainage layer, or a piped system or a combination of the two.
- Horizontal drainage: A non-permeable system (on a free-draining site this is often just a simple perimeter drain around the outside of the playing area, with a gradient no greater than 1 in 100 in any direction.

3.6.1 Vertical drainage

The SAPCA Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches describes a permeable (sub-surface) system as follows (see Figure 3):

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

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

Drains usually consist of perforated plastic pipes, bedded on, and backfilled with, clean stone which should then be compacted (where drainage trenches run beneath critical grass sporting areas they must be properly back-filled and consolidated to prevent later subsidence, which would prove difficult and expensive to rectify).

No drains should have less than 150mm cover over the top of the pipe, and no drain should be laid to a fall of less than 1:200 unless advised by manufacturer's instructions. In certain sub-soils where silting-up may be a problem, a geotextile membrane may be used to line the trench prior to backfilling. The installation of a full-size synthetic pitch may disturb any existing land drainage and render it ineffective. Where existing land drains are severed they should be connected into the new perimeter drain".

A typical drainage layout for a synthetic turf pitch (not to scale) would be as follows:

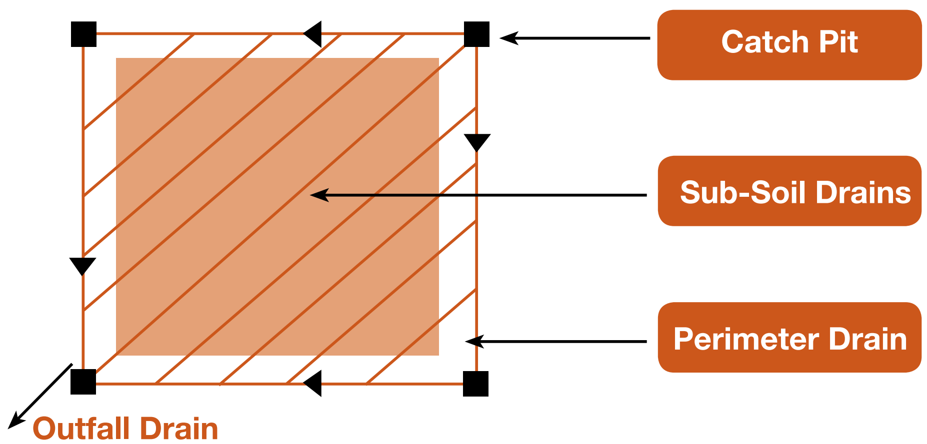

Figure 5: Typical artificial grass area drainage plan (Not to Scale)

3.6.2 Horizontal drainage

Non-permeable systems basically rely on a shaped ('crowned', elevated centre line, etc) pitch and a sealed base, thereby causing surface run-off to perimeter drains once the carpet and pad are saturated to full capacity.

This can also refer to pitches which have a consistent fall (say 1:100) to one or two sides. Even moisture levels can be an issue on large fields where outlying (flatter) areas are slow to drain.

3.6.3 Hybrid system

To overcome potential differential settlement over collection pipes, some projects are now considering an enhanced horizontal drainage system, one where a hollow plastic cell system sits on top of the sealed base and beneath the porous carpet and pad. The cell system might be 30mm or so high, and strong enough to take heavy carpet rolls and machinery.

3.7 Concrete Kerbs

Top Tip

With relation to hockey field construction, consider the design of the concrete curb/upstand as a potential rebound wall. The curb need only be 100mm high (preferably higher for raised hits) with a 10 per cent incline to provide an effective rebound function for players warming up or learning to hit.

Rebound edging - Doncaster Hockey Club

3.8 Irrigation and Reticulation

Given the specialist nature of irrigation system design, most artificial grass sports area suppliers will seek outside design and installation advice for this element of their project. When required, in most cases this work relates to elite level 'wet' field installations for hockey.

While current experimentation might change this situation, current elite level 'unfilled' artificial grass carpets for hockey must be wetted for several reasons.

- To improve the frictional and traditional characteristics of the surface (reducing the possibility of ankle and knee injuries and minimising the likelihood of friction burns).
- To minimise the problems of static electricity build-up on players.
- To improve the playing characteristics of the pitch, such as ball roll.

There are four standard systems to consider for watering elite-level hockey pitches:

Static systems:

- Pop-up sprinklers – generally located in a row along the pitch edge and down the middle of the pitch.
- Rain guns/cannons – a perimeter only system, often with three cannons down each side, with each cannon able to throw water up to half the width of the pitch.

Travelling systems:

- 'Agricultural' spraying: a mini version of the agricultural equivalent, these overhead piping systems travel across a field propelled by water pressure. They are generally very slow and therefore cannot be used to 'top-up' during the half-time break. The weight of the unit is also likely to produce wear marks along the field.

Pop-up sprinklers (State Netball and Hockey Centre, Melbourne)

- Hand held hoses - a labour-intensive method, but the most cost-effective.

The most commonly seen irrigation system on elite hockey pitches comprises of six variangle water cannons (adjustable arc and trajectory) fitted with intermittent dynamic jet breakers to influence uniformity.

Top Tip

In addition to the usually specified six cannon system (three down each side), an additional cannon or pop up sprinkler should be considered near each goal area. These would allow goal area only watering for when only that part of the field is being used (i.e. penalty corner practice) or a top up spray to this intensive use area on days of high evaporation. Request that your irrigation system be designed to isolate certain cannons/ sprinklers so that smaller areas can be watered when that is all that is needed.

The SAPCA[19] construction manual provides the following specific design considerations:

Rain Guns and Water Cannons

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

Water Cannon - Doncaster Hockey Centre

Pump

The pumps will normally be twin horizon multi-stage centrifugal units, with 22kW 400/3/50 2-pole IP55TEFC (totally enclosed fan cooled) electric motors or equal approved. These are started separately by star/delta starters with a full load running current of not more than 45 amps each or equivalent.

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

Control panel

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

- Single button control facility.
- NiCad battery back up.
- Non-volatile memory.
- The facility to retain data for a minimum of 24hrs in the event of a power failure.
- An internal transformer.
- The ability to operate station run times in minutes or seconds.
- The ability to store STX software programmes.
- Pump start facility.
- Warning signal initiation.
- A klaxon should be installed at the control panel location to give an audible warning 30 seconds prior to the operation of the rain guns.

Storage tank

The irrigation tank will ideally be located underground and be a GRP (fibreglass) construction (complying to appropriate standards) with a lockable inspection hatch. The tank capacity will be a nominal 50m^3, as far as possible without upsetting the stability of the ground.

Pipe selection

All pipes shall have a minimum of 10-bar rating and shall be of MDPE (Medium Density Polyethelene) construction.

Automatic dosing system

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

Top Tip

Recycling of water requires careful consideration of health issues. It is recommended that specific professional advice be sought if recycling is a consideration.

[19] 'The Code of Practice for the Construction and Maintenance of Synthetic Turf Sports Pitches' The Sports and Play Construction Association (2009)

3.9 Floodlighting

The potential of floodlighting outdoor sporting facilities include:

- Increased facility use.
- More flexible programming: facility managers and users can select from a much broader array of operating hours and programming opportunities.
- Greater income generation: Particularly where synthetic surfaces are involved, extending the operating hours of a facility can allow for significantly increased income generation, without the downside that is sometimes seen with a natural turf field of there being a substantial 'wear and tear' impact on the facility.

Top Tip

Independent consultant engineers with a background in sports lighting and electrical design should be contacted to help in the design of sports lighting facilities. A list of qualified contractors can be found by contacting the Illumination Engineering Society of Australia and New Zealand at www.iesanz.org and requesting the names of members experienced in the design of sports lighting. Source the Australian Standards at: www.standards.org.au

If an organisation is to be saddled with debt from such a development though, the economic viability of the project must be thoroughly investigated 'up front'. A mini-feasibility study (refer figure 2, page 57) should be conducted to ensure that the gap in income over and above operating expenses and amortisation will service loan repayments.

That being the case, attention should then be focused on the design process, with particular attention being paid to functional elements:

- Specificity: Think through the future levels of likely usage for the facility in question. Floodlighting systems can be expensive and it's pointless installing (and having to maintain) very high-level lighting if it is not necessary. As a minimum know exactly what the base requirements are as stipulated by your sports parent body; and the relevant Australian Standards.
- Flexibility: Create a system where sections (i.e. a half field) can be lit, and to varying levels (i.e. training standard, match play standard)
- Access: Are the individual lighting towers and the fields or courts themselves located to allow easy access for maintenance, emergency and other vehicles?
- Residential amenity: Sports lighting can be a sensitive subject in terms of residential amenity, and requires careful consideration and expert advice. The design of the lighting system must meet planning authority guidelines. Your specific lighting plan needs to account for desired levels of illumination, uniformity, glare and design.

Top Tip

When planning your floodlighting system, ensure that it is in line with applicable Australian Standards.

Top Tip

When planning approvals require a lighting system to shut down at a certain time, programmable controllers are a useful automatic system. These can be programmed so that some lights can stay lit for an extra five minutes or so to allow safe egress from the playing area.

Top Tip

A flashing beacon on each pole or one pole can be programmed to give a five minute warning prior to the 'automatic-off' function occurring.

Top Tip

Floodlight towers are often a good location for the provision of a waterproof power socket which can be used to hook-up cleaning equipment, public address systems, etc.

Top Tip
The maintenance plan is important and must include routine work on all the associated electronic services, the cleaning of fittings and the correct adjustment to maintain the aiming angles of the lamps. These tasks can be the basis of an annual maintenance contract with your floodlighting contractor.

Top Tip
An 'hours-run' counter can be included in a lighting system control/monitoring equipment as a handy guide to a systems maintenance plan implementation.

3.10 Fencing

Philosophical issues related to the fencing of community sporting spaces have been discussed in Section 1.11.1. Artificial grass sporting facilities are more likely to sustain potentially expensive damage if left unsecured, so most local government authorities or schools will opt to install fencing of some sort around their artificial grass sporting facility.

Other reasons why fencing is considered include:

- To retain balls within the playing area.
- To allow spectators to view the game safely.
- To keep animals out of, or off the pitch.
- To protect the pitch from unauthorised use or vehicle access.

If fencing is to be used, the choice of fencing style and dimensions are usually dictated by the priority sport, site constraints and budget.

Some ideas to consider when designing your fencing:

- Try to always include a double gate (wider than a set of hockey goals) so maintenance and emergency vehicles will have access.
- Consider the installation of a removable lintel above your double gates so that large goals or equipment can be easily moved in or out of the field.
- All gates should open outwards for player safety.
- Provide boot or shoe cleaning equipment at all access gates. Contaminants must be removed from shoes before players enter the playing area.
- Gates should be located so as to help avoid bottleneck areas, particularly at points where team changeovers would occur.
- Gate thresholds should be level or slightly ramped (not stepped).
- Fencing should incorporate recesses for goal storage when not in use (see section 3.15). Fence-fixed foldaway goals are an alternative where space is an issue.
- If the activity space is to be used for Futsal or similar (where the end of court walls are 'in play'), the goals should be recessed behind the line of the end wall.

Recessed goals – Taylors Lakes

Top Tip
Consider designing and utilising the concrete kerb/upstand at the base of the fence (see photo overleaf) as a potential rebound wall for hockey hitting practice.

Rebound area-base of fence.
Footscray Hockey Centre

Top Tip

Ensure that the fence railing at the bottom of any fence is less than the ball height above the concrete kerb/upstand so balls cannot fit under the fence.

- All steel supports, fencing and fittings should be heavy duty galvanised or coated steel. Clips and fixings should have no sharp edges, nor face inwards.
- Where site security is not an issue, or there is already a high security fence surrounding a site, often a 1.2m high fence is enough around the actual playing field.
- Be conscious of the exact field or court dimensions and the required safety run-off spaces.
- Steelwork should be galvanised to minimise premature corrosion, and can be plastic coated (black or green) to improve appearance.
- Consider upgrading fencing beside and behind goals so as to protect the fencing from the repeated impact of balls.

Top Tip

The size of the diamond and the thickness of the wire strand have significant impact on the performance of the fence in terms of distortion from ball and player contact.

Top Tip

Consider the construction of a rebound wall within/instead of some fencing. These types of walls offer practice opportunities to individual players.

Rebound wall incorporated in fence
(Gold Coast)

Top Tip

The edges of many pitches can be affected by wind blowing in dirt and rubbish with the relevant run off and field edge becoming 'muddy' or contaminated. Determine the wind patterns at your facility and consider a plinth or barrier at the base of the fence to prevent this occurring.

A useful resource relating to fencing is the SAPCA (Sports and Play Construction Association) Code of Practice 'The Construction and Maintenance of Fencing Systems for Sports Facilities'.
Website: www.sapca.org.uk

Off field cage for retractable netting (East Keilor)

3.11 Divider Netting and Screening

Cross – field retractable netting

It is a good idea to consider divider netting within a large activity space so as to improve flexibility and usage.

Considerable thought should go into the likely or possible programming that could occur at the planned facility. The answers that emerge from that process will determine what spaces will be necessary, either permanently or via partitioning.

The typical arrangement is divider netting suspended from tensioned steel cables hung across the pitch (removable when not in use). In this way a full sporting field can be divided in two, into thirds, or into quarters. The latter is often seen when schools are using a full pitch for four rows of tennis courts.

Top Tip

If designing a full artificial grass soccer pitch so that it can be divided into thirds or quarters for small sided games or Futsal (ie. by the use of divider netting - no solid side walls in place), play should be within lined areas, not right up to the divider netting. Consider installing cross-field blue lines either side of the netting as safe 'boundaries' for the cross-field courts, but understand the implications of additional linemarking through undertaking thorough consultation with all relevant sporting peak bodies.

Futsal courts

Cricket practice areas are now often designed as a large flexible space utilising moveable divider netting between pitches. When the netting is retracted (and presuming that the artificial grass surface is relatively uniform), the resultant open area can be used for a variety of sporting activities.

Multi-use practise space - Eltham

Top Tip

Some of the new ‘open-plan’ cricket practice net configurations (see photo below) feature netting storage cabinets within the activity space. These cabinets can be damaged by fast-moving cricket balls or may be an obstruction when the overall space is being used for small games. Consider padding or relocating the cabinets outside the fence-line (see photo p74).

Multi-use practice space - Eltham

Top Tip

If screening of a space is being considered (either for site screening, as a windbreak, as advertising), the fence design – especially pole and footing strength – need to be sufficiently scaled to cope with the wind forces that will be transferred from the screening into fence infrastructure.

3.12 Shoe Cleaning Areas

Algal contamination of artificial grass or its infill medium is a problem where contaminants are either blowing onto a sports surface, or where players are transferring it to the playing surface through their footwear.

Contaminants blowing onto an artificial grass surface are difficult to control and should be prevented from becoming a problem in the first instance. Dusty car parks should be sealed and windbreaks installed where possible.

Algae on carpet

A more difficult situation to control is participants bringing dirt, parts of leaves and stones on their shoes on the journey from the car park to the playing area. Thought needs to be applied to the design of field or court entry points so they also become shoe-cleaning channels. Good design should ensure that players have to go through a shoe wash area (a narrow walking space in which the player may find shoe-cleaning brushes, a tray of water-saturated artificial turf, etc).

Shoe Cleaners

Shoe cleaning bay - Footscray Hockey Centre