Cranfield UNIVERSITY

Maintaining Synthetic Turf: Sand Filled Systems

The Cranfield – IOG Guidelines

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MAINTAINING SYNTHETIC TURF: SAND FILLED SYSTEMS

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Centre for Sports Surface Technology, Cranfield University
Version 1.1 September 2008

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MAINTAINING SYNTHETIC TURF: SAND FILLED AND SAND DRESSED SYSTEMS

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Preface

In 2003, Cranfield University began a 4 year doctorate research programme to develop a set of guidelines for maintaining synthetic turf. The project, funded by the Institute of Groundsmanship (IOG) (www.iog.org) and the UK Government's Engineering and Physical Sciences Research Council (www.epsrc.ac.uk), had the task of creating a new set of guidelines to help support the IOG's membership in their maintenance of synthetic turf – a set of guidelines based on a body of evidence. Following completion of that research, Cranfield University have prepared this document with the Institute of Groundsmanship – aimed at groundstaff and facilities managers alike.

Starting from scratch as far as scientifically researched information was concerned, the study had to focus on one particular system of synthetic turf pitch. This has raised the question 'Why focus on 2G, when 3G is the new standard for pitches?' This was answered at the 2008 IOG Conference in Liverpool when delegates were asked 'Do you maintain synthetic turf?' 90% of the audience responded yes. Of that 90%, 90% were looking after 2G pitches. The methods here are easily transferred to filled 3G surfaces and when they have been researched in detail we shall publish a second set of recommendations for 3G turf.

The IOG 2012 Fund was established to make grants available for educational, research and benevolent purposes – developing and supporting the grounds management profession, and those involved in it. Funds are allocated from events such as IOG SALTEX and IOG SCOTSTURF, plus reserves from central funds. As the only national organisation representing groundstaff from across the industry, the IOG is committed to education and research and the development of new techniques and products to make the care of sports surfaces and amenity facilities as scientific as any other industry discipline.

The IOG 2012 Fund has successfully provided financial support to enable a number of major research projects in the production and maintenance of surfaces for sport. The fund has also made it possible for grounds care staff to work towards higher education qualifications, including Masters Degrees at Cranfield University and supported further education colleges.

Introduction: Why do you need to know about maintaining synthetic turf pitches?

A synthetic turf pitch is selected for its high usage capacity, multi-sport capability and 'most-weather' suitability (although not quite 'all-weather'!). Installing a synthetic pitch is a big investment, but the benefits and rental potential can cover these costs and eventually return a profit. These benefits, and the rental potential will reduce if the quality of the surface declines over time – to prevent this, a good management strategy and maintenance programme are essential.

Aren't synthetic turf pitches maintenance free?

No. Let's get that one out of the way. Actually, the idea that a synthetic turf pitch (STP) is maintenance free is not really very widely held. In a survey of owners and operators of synthetic turf surfaces, researchers at Cranfield[1] determined that relatively few respondents believed the 'maintenance free' myth. This was because either they had experienced the consequences of not maintaining their pitch or their supplier had informed them of the consequences of not maintaining their pitch, both in terms of performance and warranty invalidation (nowadays most warranties stipulate that maintenance is required and most manufacturers supply guidance on how to maintain their products).

If your pitch is still under its warranty period and maintenance is stipulated then we strongly recommend that you still follow the manufacturers' recommendations. These guidelines are focussed on older sand-filled 'Second Generation' or '2G' pitches, which are still the most common and are likely to be older and have less prescribed maintenance than new longer pile, sand/rubber-filled 'Third Generation (3G)' pitches.

These older second generation pitches are often heavily used for a number of sports and were sometimes only supplied with a one-paragraph to one-page maintenance schedule, of varying usefulness.

Are you thinking of purchasing a synthetic turf pitch?

Perhaps your organisation is thinking of purchasing a synthetic turf pitch or you will be responsible for maintaining one. How much will you need to budget for maintenance? What maintenance solutions do you have? Will you use in-house capability or will you contract out?

Although the 'no maintenance' myth was busted a long time ago, STPs are often thought of as 'low maintenance'. Well, here's food for thought… In a 2003 Cranfield University survey[2] of independent school head groundstaff, average annual expenditure on maintenance of a synthetic turf pitch was £8000 per pitch. How did this compare to annual expenditure on a natural turf pitch (NTP)? It was more. Annual expenditure on a natural turf pitch was £7500 per pitch.

It costs exactly the same amount of money to look after a synthetic turf pitch as a natural turf pitch – so where's the 'low maintenance' saving? Well that comes from the hours of use each pitch can sustain. Typical weekly hours of use in the same survey were 44 hours for STPs and 4.1 hours for NTPs – a tenfold difference. So when you compare maintenance costs on a 'per hour of use' basis, rather than a 'per pitch' basis – the cost of maintaining STP systems is 10 times less than that of an NTP system (in this context you need 10 NTPs to every STP – so 10 times the maintenance cost.)

[1] McLeod, A.J. (2008) *The management and maintenance of second generation sand-filled synthetic sports pitches*. Engineering Doctorate Thesis. Cranfield University, Cranfield, UK. Available at https://dspace.lib.cranfield.ac.uk/
[2] McLeod, A.J. (2003) MSc Thesis, Cranfield University, Cranfield, UK.

But synthetic turf pitches do need maintenance. Why? Where's the evidence? How do I do it? When should I do it? Should I do it, or should I get someone in to do it? How much is it going to cost? To answer all these questions – read on.

Part 1: The 2G synthetic turf pitch and why it needs to be maintained

How a synthetic turf pitch works

Synthetic turf pitches are made from a number of components – if you understand how these components interact, then you can understand why pitch problems occur and why maintenance is necessary.

Going down through the profile (Fig. 1), the four key components are:

1. The tufted or woven synthetic turf fibre carpet and its backing material
2. The infill
3. The shockpad
4. The asphalt and stone sub-base

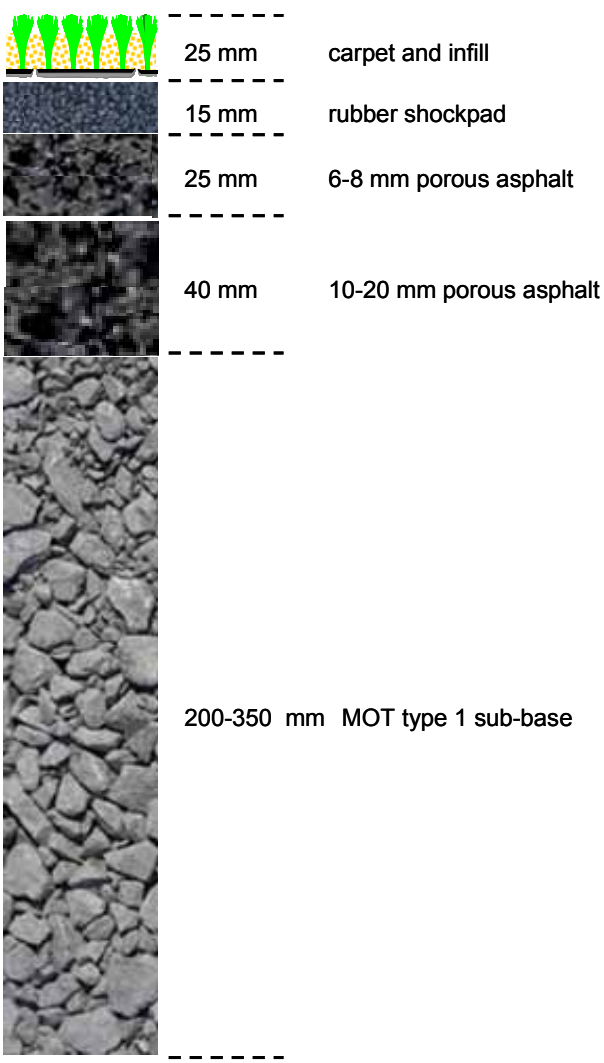


Fig. 1. A cross-section of a typical 2G pitch
(to approximate scale)

The **synthetic turf fibres** provide the cushioned surface for playing sport. Without the fibres, the ball would roll too far, traction would be less and the surface would be stiffer (it would not deform as easily). They are also green – which makes it look more like natural turf. The **backing material** is critical – it holds the turf fibres together and allows the pitch to be laid and to stay in place.

Over time the synthetic turf fibres are abraded and worn down – this shortens pile height as the pitch ages. Fibres can also split along their length, accelerating this process. This process is known as fibrillation and is actually a design feature of some carpet fibres. If the fibres and infill are not maintained correctly, the fibre can fold over at the top creating a permanent fibre cap (Fig. 2) – this stops water moving through the pitch and can increase pitch hardness and reduce traction. As pitches age (or in poorly manufactured pitches), tufts of fibre can be pulled easily from the backing material – degrading pitch quality rapidly – watch out for this.

We work on a typical lifecycle of 15 years for a well maintained 2G pitch. They can last longer, or fail sooner if poorly manufactured or poorly managed.

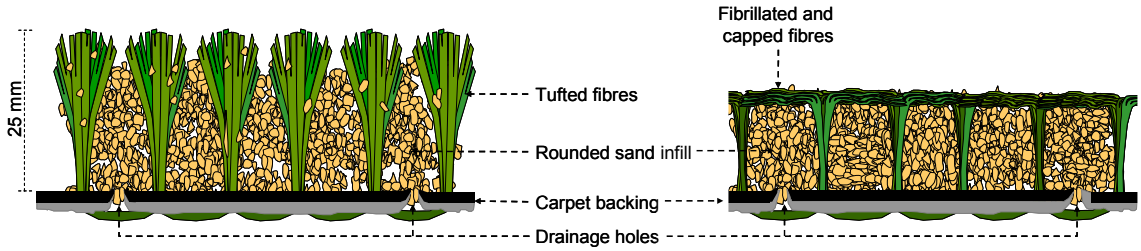


Fig. 2. The role of the infill. (Left) When topped up to the right amount, infill supports the fibres in an upright vertical position. It also acts as a filter to keep the drainage working. (Right) When there is not enough infill, the fibre folds over and eventually forms a permanent cap that affects performance and slows drainage. Note that fibre length is equal but fibre height is greater on the left. The relationship between fibre height and infill depth is critical – see Part 2 for more information.

The **infill matrix** has many functions. Its first job is to keep the synthetic turf fibres upright. Without the infill, the fibres would simply flatten, giving a slippery surface with high ball roll that didn't drain. The infill matrix also holds down the carpet – each square metre of turf could have 20-25 kg of sand infill – so over a 110 m x 96 m area (a typical football pitch with 3 m run-offs) that's 211-264 tonnes of sand.

The infill is critical for surface performance – the amount of infill affects the ball-surface and player-surface interactions. The infill is also designed to act as a filter, stopping particulate material from migrating into the carpet backing material and preventing drainage of water. When it is installed, the infill matrix comprises the infill sand and any water in the pitch. Over time, the infill matrix becomes contaminated with finer material – such as soil from muddy footwear, wood and fibres from hockey sticks, fizzy drinks, chewing gum, leaves, atmospheric dust deposits, and the list goes on…

The amount of infill over the pitch area, its distribution and the level of contamination are critical for pitch performance and are key drivers for maintenance and are closely related to fibre height (Fig. 2).

Because the shockpad and the stone/macadam sub-base are below the carpet, maintenance has less of an interaction with them. We need to understand their role in the system and their interaction with the upper layers of fibre and infill though to understand how a pitch works.

The **sub-base** provides the stable, level surface for the pitch – building it correctly is critical to the whole life-cycle and quality of a pitch. If the construction contractors get this wrong the project is simply doomed until it is put right. The sub-base is core to the drainage – it is the greatest thickness of material and therefore the greatest distance travelled by water on its way to the drainage system. Within reason, and providing it is constructed properly – a sub-base can outlive 2 or 3 pitches – as long as it remains stable, in place and porous.

Between the sub-base and the carpet/infill, the **shockpad** helps reduce the stiffness of the whole system – this makes it more comfortable to play on and reduces ball bounce to tolerable levels for play. A good shockpad should outlast two or three pitches but they can degrade over time – either by breaking down or by being contaminated with finer particles from the layers above. It is important the you select machinery weights and tyres carefully. Excessive loads over small areas can damage the shockpad; more of that later. Like a sub-base, the shockpad must remain stable, in situ and porous.

The water flow pathway

Synthetic turf pitches are designed to be free draining – as soon as they become waterlogged, play is affected. When a pitch is new, water will drain from the surface rapidly – but over time drainage slows. To understand why this happens we need to understand the water flow pathway (Fig. 3).

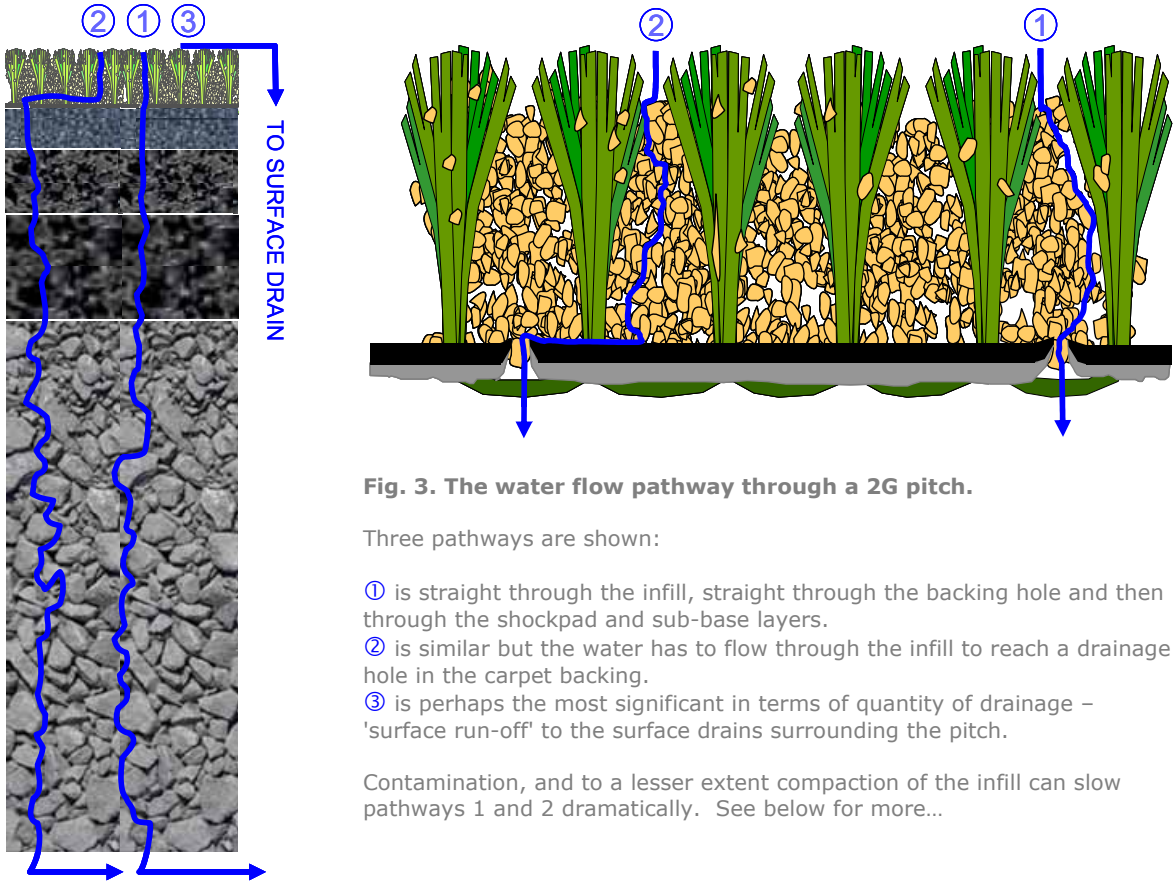


Fig. 3. The water flow pathway through a 2G pitch.

Three pathways are shown:

① is straight through the infill, straight through the backing hole and then through the shockpad and sub-base layers.
② is similar but the water has to flow through the infill to reach a drainage hole in the carpet backing.
③ is perhaps the most significant in terms of quantity of drainage – 'surface run-off' to the surface drains surrounding the pitch.

Contamination, and to a lesser extent compaction of the infill can slow pathways 1 and 2 dramatically. See below for more…

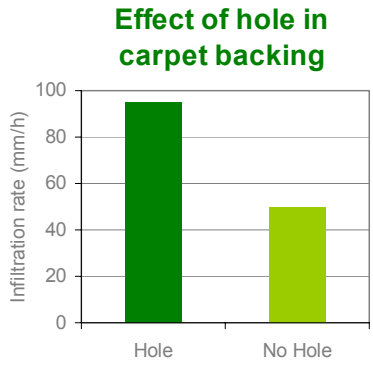


Fig. 4. Why are there holes in the carpet backing?

Well the backing is relatively impermeable in some pitches, so the holes are needed to allow drainage. Without the holes, infiltration is halved.

As you can see, surface water has to pass through the turf fibres, through the infill, past the backing material, through the shockpad, through the tarmac layer, through the stone sub-base and into the drainage system. The system is designed so that water moves through that pathway quickly – this is achieved by having vertical turf fibres, a porous infill, a permeable backing (that's why it has drainage holes, see Fig. 4.) and porous shockpad and sub-base. These systems have wide pores, much wider than soils, so that water drains through quickly. Unlike a natural turf system you do not have to hold the water for the plant to grow (although a bit of water in the infill can help playability and reduce sliding friction – which causes skin burns).

Pores must be connected for drainage to take place. Anything that blocks the connectivity of pores or reduces the size of pores will reduce the conductivity of water through the system. Pitches that sit wet for long times are prone to waterlogging, algae growth and moss growth; all of which lead to a surface that looks poor quality and plays poor quality. It's a vicious downward spiral too.

What happens when you don't maintain?

There six key signs that maintenance is needed or the pitch is ageing are:

1. Wet spots, poor drainage and algae
2. Contaminated infill
3. Fibrillation and capped turf
4. Worn patches and seam/line rips
5. Fibre nap – where the fibres are orientated in one direction
6. Un-even infill distribution

How can maintenance help with this?

It's obvious that blocking the water pathway must be prevented. Routine maintenance can only affect the surface from the carpet backing upwards, so maintenance is all about:

1. Keeping the surface clear of debris for play – this means the ball rolls smoothly, players don't trip and the litter doesn't break down to block infill pores.
2. Keeping the turf fibre upright – by doing this fibre capping is prevented, keeping the water pathway open – also the formation of naps is prevented.
3. Keeping the infill evenly distributed to the right depth – this will ensure that the fibre is kept upright and ball bounce, ball roll and traction do not vary across the pitch.
4. Keeping the infill clean – this prevents pores in the infill being contaminated and blocked – usually by soil, dust, debris, fibre fragments etc.

Fig. 5. Pitches in need of maintenance
(Top) A visibly contaminated infill. Problems like these need expensive solutions – it is much better to prevent than cure.
(Bottom) A pitch that has begun to cap, notice how the fibres appear to flatten. Keeping infill topped up with the right sand is critical

This is achieved by a range of techniques from leaf collection to jetting with compressed air. These are all discussed in Part 2 of these guidelines. But there are still some important points to consider…

What else can be done?

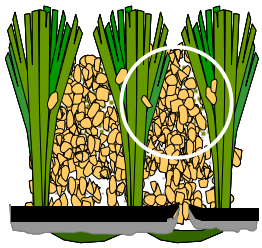
Think about the day-to-day pitch management strategy. A useful tip is to rotate 5/6-a-side pitches to even out wear – don't let teams use the pitch nearest the gate all the time for example. The same goes for practice sessions – penalty corner drills should be spread between both goals.

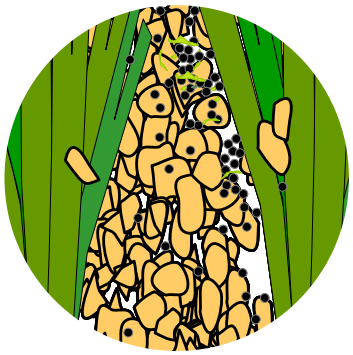
Educate staff and coaches. Staff and coaches responsible for team activities have a key role to play. When they are informed about the relationship between wear, cleanliness and on-pitch behaviour, and the quality of the pitch, a culture of best practice will prevail. They are critical for encouraging good practice, and discouraging bad practice, by players.

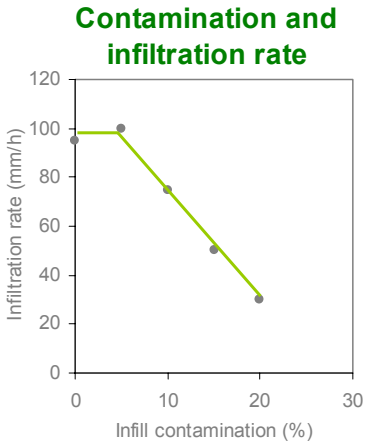
The effect of infill contamination on surface performance

As infill contamination goes up, infiltration rate and pitch drainage goes down. This creates all sorts of playing performance problems.

In a survey of 2G (short pile, sand-filled) STP sites across England, contamination levels in contract-maintained pitches were 1.9% to 9.1%. In unmaintained pitches, contamination is higher – the highest we recorded was 19%. When contamination is 10–15%, infiltration will fall below the minimum FIH standard[3] for hockey (50 mm/h) [1]. Infill contamination also slows the rate at which the pitch dries out, encouraging the growth of moss and algae.







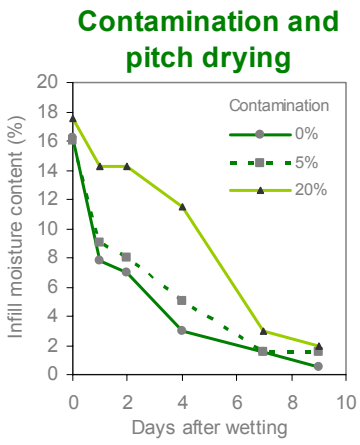


Fig. 6. The effects of infill contamination

Contamination in the infill from fibre particles, dirt etc. blocks the pores between the infill grains. This slows the speed at which water flows through the infill.

This is shown in the graph (left) showing what happens to infiltration rate as infill contamination increases.

Also by making the pores smaller, the pitch takes longer to dry out because it holds water more strongly (like changing from a sandy soil pitch to a clay soil pitch).

It is essential to keep infill clean – and this shows why.

It is important to note that maintenance only slows the rate of accumulation of contamination in the infill. Our research has shown that contamination will increase over time, even in maintained pitches – it is very difficult (and expensive) to remove it entirely, but it is possible in the right conditions. The aim is to slow the rate of contamination accumulation in the infill, to minimise the effects long-term.

How do you measure contamination in an infill? Part 2 includes a method for determining how much infill contamination there is at your site. Also, a video tutorial for the method is available from our website www.cranfield.ac.uk/sas/sst

[3] FIH. Handbook of performance requirements and test procedures for synthetic hockey pitches – outdoor. Federation Internationale de Hockey, Lausanne, 1999. Available from www.fihockey.org

The effect of infill depth/quantity on surface performance

As the depth of infill decreases relative to the fibre length, playing quality will decrease (Fig. 7). Although the amount of infill in a pitch will reduce over time, fibre length also reduces (at 0.9 mm/yr on average), so careful monitoring of both infill depth and pile height is required (see Part 2).

Uneven redistribution and/or compaction of infill during play is the most common problem. Generally sand is moved from high traffic areas such as pitch centres and goal areas to wings and less used areas. This affects the depth of infill relative to pile height.

There is an optimum amount of infill per unit area. For a 25 mm fibre length, the optimum infill rate was 25-30 kg/m^2. Any less than this and the fibre was not supported enough, causing a risk of fibre capping (see below) and increasing ball bounce – when infill quantity was reduced from 30 to 10 kg/m^2 the ball rebound increased 60%.

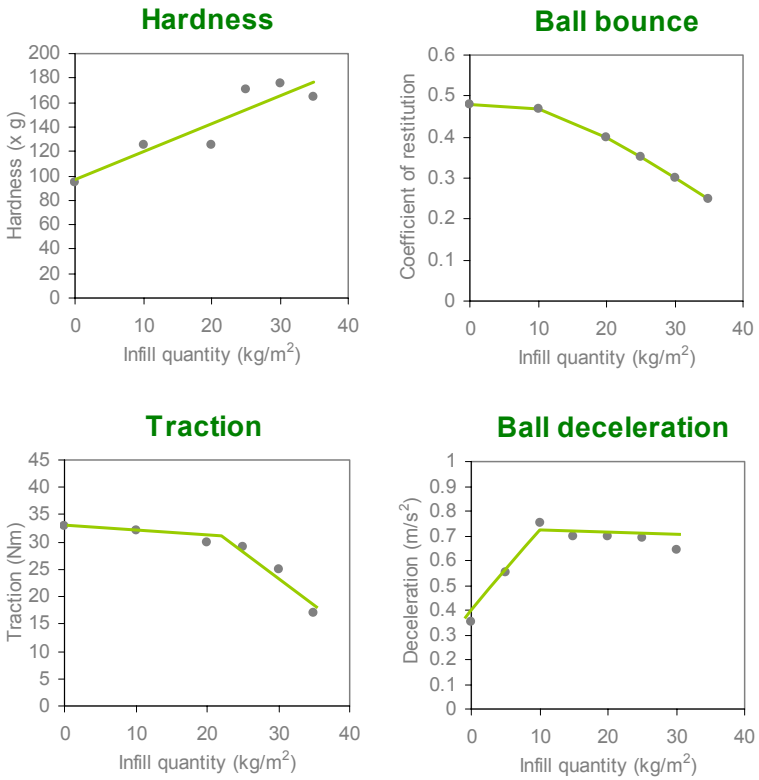


Fig. 7. The effect of infill amount on pitch performance, for a 23 mm 2G surface.
Too little infill and ball bounce is too high (the greater the coefficient of restitution, the higher the ball bounce) and the ball will roll too far (higher ball deceleration is desirable – within limits!). But if you have too much then the pitch is too hard and the traction too low for player comfort and stability. In this pitch, 25 kg/m^2 was optimum.

Note that these quantities are specifically for a 23 mm pile length. Longer or shorter piles will require more or less infill respectively.

Fibre condition

There are two different principal fibre types used in synthetic turf, monofilament fibre and fibrillated tape. Most older 2G surfaces are fibrillated tape fibres. In these pitches the structure will change over time as the fibres wear and breakdown in to smaller filaments with use. This changes ball roll and surface stiffness/hardness. Also, the amount that the fibre is displaced during contact with the ball will affect ball deceleration.

The main causes of fibre breakdown over time are ultra-violet (UV) light from the sun and the mechanical stresses of surface use. UV causes fibre-surface cracking, increased fibre brittleness and lower strength. There's not a lot you can do about UV radiation from sunlight as an owner/operator but you should make sure that you only purchase pitch systems that pass the required standards for UV stability (they should be chemically engineered to do so). You also need to understand that if your pitch is in an exposed area, or in a country where UV radiation is high, then your pitch could degrade more quickly.

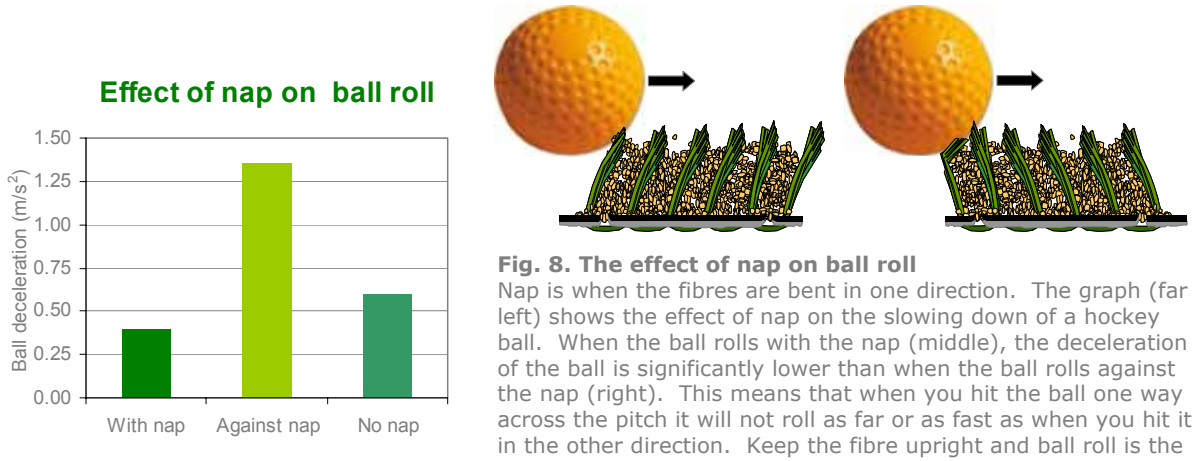


Fig. 8. The effect of nap on ball roll
Nap is when the fibres are bent in one direction. The graph (far left) shows the effect of nap on the slowing down of a hockey ball. When the ball rolls with the nap (middle), the deceleration of the ball is significantly lower than when the ball rolls against the nap (right). This means that when you hit the ball one way across the pitch it will not roll as far or as fast as when you hit it in the other direction. Keep the fibre upright and ball roll is the same in every direction

Napping occurs when pitches are only brushed in one direction (even if they are brushed up and down a nap will form if the 'up' is always the up and the 'down' is always the down!) A nap in the turf really affects ball roll – the ball will decelerate more if fibres are pointing in the opposite direction to the ball roll and much less when they are pointing in the same direction – creating a game of two halves, literally. This effect is sometimes seen on snooker tables and when running your hand over some fabrics. Localised napping also occurs at the top of D's and on the short corner markers in hockey. Strategies for avoiding this are given in Part 2.

The cost of maintenance – is it worth it?

It's a good question – if the benefits don't outweigh the costs – then why bother? Well to answer this question we have to look for evidence of the benefits and try and put costs to what happens if we don't maintain the pitch. A 15 year old, well maintained pitch, used for 2000 h/yr (of which 1000 h/yr are rented externally), will return £133k over its lifecycle (using 10% discount factor in a net-present-value model).

What if an alternative strategy is used? What about a pitch that has only the bare minimum maintenance but only lasts 12 years? Well such a pitch would return a loss of -£57k. This arises because the pitch will lose quality quickly (after 4 years in this model) and external bookings will be lost to other facilities. The financial operation of a synthetic turf pitch is highly sensitive to eternal booking revenue – make sure that this is looked after by looking after your pitch quality.

Can you over-maintain a pitch?

The answer is actually yes, but it would be uneconomic to do so (except for some poorly manufactured carpets). What we mean by that is that yes you can over power-brush a pitch for example – but the cost of doing so, certainly on a contract basis, would be uneconomic. For details, including signs of over-maintenance – see Part 2.

So how much maintenance should you do?

We suggest maintaining a pitch on a 'per hours of use basis' – just like a mower, tractor or other piece of machinery – the more you use it, the faster it will wear and degrade – therefore the more frequently it should be maintained. However, this does not work in reverse – if you use the pitch less, it could still require the minimum amount of maintenance as problems can build up as quickly when a pitch is not used enough as to when it is over-used. A basic programme of maintenance for 'an average pitch', based on hours of use, is in Part 2. Schedules will still depend on local conditions such as surrounding trees, proximity to roads and play grounds etc.

Important considerations at the pitch design stage – 'Prevention is better than cure'

It is worth mentioning at this stage that there is so much that can be done before a ball is ever kicked or a brush is ever dragged. Right from the concept or design stage you, your consultants and the contractors should be thinking about ways to prevent the carpet fibres being anything but vertical and how to keep contamination of the infill to a minimum. There are various strategies for this:

1. Work out your planned hours of use (realistically) and budget maintenance accordingly. Look for a ratio of 1 hour of maintenance for every 10 hours of use.

2. Be aware of carpet suppliers who state that maintenance should be limited to very small amounts – this could well be due to poor fibre wear resistance or poor binding of the fibre in the carpet backing.

3. Establish a set of operating rules for pitch users, publish them to new users, put them up on signs around the pitch – and enforce them. Outline what is acceptable and what is unacceptable behaviour. Important rules include:
    a. Clean, suitable synthetic turf footwear only
    b. No food or fizzy drink (including chewing gum)
    c. Keep to marked pathways
    d. Use litter bins provided
    e. No animals
    f. No smoking
    g. Spectators must not stand behind goal ends during hockey games

4. Provide litter bins and empty them frequently.

5. Players should always use clean appropriate software designed for synthetic turf pitches. Spectators should always clean their shoes too.

6. Make sure players and spectators can approach the pitch on clean dry hard surfaced paths – if they have to cross turf or soil they will bring mud onto the pitch. Also have a look at path alignment and fencing to ensure that paths take the most direct route – discouraging corner cutting across the grass.

Fig. 9. Things to avoid
(Top) Avoid unsightly litter by providing bins, encouraging/enforcing their use and emptying them frequently. Remove litter like this quickly – if left it only encourages more. Also, over time, litter contributes to infill contamination.

(Bottom) Make sure that players, spectators and equipment can access you pitch without treading on muddy areas or natural turf pitches. Provide hard-standing for people and machines and avoid infill contamination

Make sure that machinery can also access along the same pathway or a dedicated hard access route – you do not want to have to drive tractors and drag brushes over muddy wet playing fields and then onto the synthetic pitch in the winter.

7. Ensure that fence height is sufficient to stop balls being kicked onto surrounding pitches – if this happens then somebody will go and retrieve it, bringing some of the field back with them.

8. Try to limit entrance and exit traffic to one gateway – it is common to have more than one gate – for emergency access or vehicles access etc but try to keep pedestrian traffic to one gate (without affecting safety escape routes). This means that sacrificial 'doormats' of carpet off cuts can be placed in the heavily trafficked gateways. Also provide boot brushes and scrapers and enforce their use.

9. The use of trees to limit light pollution from floodlights is a common strategy in the planning application process but understand that trees will shed leaves and sap onto pitches (even coniferous trees will shed cones and needles) – try to clear pitches of overhanging trees and trees where leaf litter will blow onto the pitch.

10. Built in, recessed equipment storage areas are a good design feature in a pitch – it keeps equipment tidy and can improve safety.

11. Plan to get the right machinery and to allow it access to the pitch.

Getting the right machinery and kit

When selecting machinery there are many factors to consider. Your first will be cost/price. This is common and important but you must make sure you are getting the most suitable machine that you can afford. If all you can afford is unsuitable, then you should be thinking about raising some more funds to get the right tool for the job. There's no point in buying a machine that's not going to do the job you want it to do.

Along with cost, you should also consider:

- Effectiveness and suitability for the job – ask manufacturers to demo and measure the effectiveness (look at working depth, job quality etc – have a look at our field performance data in Part 2).
- Working width – the wider the working width, the more area you can cover in the same amount of time – reducing your operating costs. But remember, you still have to get the machine from the shed, onto the pitch – think about access routes and gate widths.
- Think about flexibility and multitasking for equipment – can it be adapted in different ways to perform different tasks? (Be careful about mixing equipment with natural turf operations though – you must prevent soil contamination of the infill).
- Secure, suitable storage. Without it your equipment will not last and will be a health and safety liability.
- Storage-to-pitch hard access. You need to be able to get from the sheds to the pitch via roadways/pathways without going over soil or natural turf.
- If you are planning to use a tractor that you use on the fields, then a wash down area is essential to clean mud off the tractor before going on to the synthetic pitch.
- Ground pressure: think weight, tyre size and tyre pressure. (See 'Limit the load – limit the wear' below)
- Turning radius and scrubbing (See 'Limit the load – limit the wear' below)
- Equipment durability and maintenance. Make sure that the equipment will do the hours you want it to do – whether it is a drag brush, a power brush or a tractor.

Limit the load – limit the wear

It is tempting to think that compaction and load damage on synthetic turf is much less of a risk than on natural turf. This isn't the case however. Yes the sub-base is engineered a bit like a road and can carry heavy machinery, but the carpet and infill system is much more vulnerable to both compaction (vertical loads) and shearing (horizontal loads).

Three golden rules:

1. Limit the pressure: either by reducing machinery weight or by increasing the machinery footprint (wider tyres, lower tyre pressures, tyre profile selection). A machine that is any bigger than necessary is just adding extra load to the carpet.
2. Limit your turning radius and speed: tight turns do speed up work rates but they also increase horizontal shearing forces on the carpet – seams are particularly vulnerable. Tyre profile is also important – tyres with more rounded edges will act less like a blade as you turn.
3. Make sure your brushes do not damage the fibre: select brush material carefully – it is better to wear the brush than the carpet, so don't go for something too stiff. Also don't over ballast the brush to achieve penetration depth.

A basic machinery shopping list

1. A 1 to 2 m drag brush
2. A sweeping / surface litter collection device
3. A leaf blower / collector as necessary
4. A prime-mover (tractor/buggy) if necessary
5. Drain cleaning equipment

When to consider a contractor and what to look for

Consider a contractor when it is of cost benefit to do so. It might be that in your operating model you are familiar and comfortable with using contractors for everything from spraying pesticides and painting the walls, to security or cleaning. In the case of synthetic turf pitches, this could be for jobs at a less-than-weekly frequency, such as power brushing, one-off repairs, drain cleaning etc.

You need to look for the following when considering contractors

1. Reputation and recommendations from people you know and trust.
2. Do they use the correct brushing techniques for your surface (see advice on different techniques in Part 2).
3. Look for how long they have been in the market and their track record.
4. Is synthetic turf maintenance a speciality for the company – do they have a dedicated division and equipment – or do they throw a PTO powered brush on the lorry with the tractor and gang mowers to mow your outfields and then brush the pitch with the same tractor?
5. Find out whether they will be able to plan their brushing schedule to fit in with your planned maintenance schedule and your low-usage times.
6. Do they offer 2-3 year packages to help hold costs down (although you need to determine whether the risk of doing so fits with your operation)?

Contracted maintenance is common in synthetic turf operations, but if you prefer to handle jobs internally with well resourced, well trained staff, then that is entirely possible. Developing a positive working relationship with a reliable, experienced contractor can be of great benefit to your synthetic turf pitch.

Part 2: How to maintain synthetic turf pitches

Assessing the state of play: initial investigations

Before starting any new maintenance programme, you need to look at the condition of the turf fibres and infill. The following is a step by step assessment of the current pitch condition. This allows you to investigate the causes of any problems and to set a benchmark for measuring the effect of any maintenance you undertake.

If you are in the process of purchasing an STP system or you have a brand new installation don't think about skipping this step – setting a benchmark at the start will allow you to monitor the change in the pitch over time as it is used and maintained.

Note that this is not a performance quality assessment – this is not the type of testing used to determine whether your pitch is a FIFA 1* or whether the ball roll meets the FIH standard for hockey. The following tests are for maintenance purposes and look at factors that are related to the key components and signs of problems discussed in Part 1.

*We have provided a '**Pitch Condition and Maintenance Audit**' in the back of these guidelines* – you can photocopy it and take it out in the field or a downloadable version, that you can print off as many times as you like, is available from our website www.cranfield.ac.uk/sas/sst

Step 1: General survey

A general survey can be conducted whilst walking around the pitch. Get the clipboard out and make notes as you go – this will help you prioritise your actions. Eliminate the obvious: have a look around the site

- Look for standing water or evidence of standing water such as tide lines.
- Check for 'dunes' or 'ribbing' from accumulated, unevenly distributed infill material.
- Look for problems such as litter, muddy areas, worn turf and split seams.
- Look for signs of abuse such as graffiti and vandalism – remove as soon as possible – it's contagious, removing it will deter further attempts.
- Check that fencing is intact, in good condition and that all gateways etc. function. Also check kick boards / toe boards.
- Check that bins are emptied and are used.
- Check that run-off areas are in good, safe condition and clear obstacles. If tarmac or paved area, check that they are not coated with sand or are grimy and slippery.
- Locate high wear areas and check for damage. Hockey: goalmouths, top of the D and short corner markers. Football: goalmouths, 6-yard boxes or D's and centre areas. In all sports the touchline area nearest the principal access and the principal access area itself will be high wear areas.
- Check for vegetation growth in the perimeter of the pitch to insure that it does not invade playing areas.

Fig. 10. Looking for general problems
(Top) ribbing from uneven infill distribution.
(Bottom) Make sure that run-offs are kept clean.

Step 1: General survey (continued)

- Check the condition of seams and lines, identify repairs as necessary
- Check surface drain condition and function.
- Check that curbs are not pronounced and a trip hazard.
- As you walk across the pitch check for rucks in the carpet and ensure that conditions are uniform under foot.

Fig. 11. Things to look out for (before they ever get like this) (Top left) seam failure. (Top right) poorly patched areas. (Bottom left) in-laid line failure. (Bottom right) graffiti. Get rid of graffiti quickly otherwise it encourages more.

Step 2: Access and surrounds

Don't just look within the fence; look at what is going on around.

- Inspect the floodlights for damage and check functioning of all bulbs.
- Periodically (2-3 years as necessary) clean the floodlight glass covers to maintain luminance.
- Check that pathways are clean and safe?
- Check pathways are being used. Are people cutting corners? Are barriers / signs required?
- Try and limit bare areas of soil nearby – grass over where necessary.
- Look at trees and overhangs to check that leaves, needles and sap are not getting on to the pitch.
- Are foot brushes clean and in good order?
- Are litter bins emptied and usable?
- Are 'back doors' being used to retrieve balls from muddy pitches? Can something be done about this?

Step 3: Pile length, pile height and pile condition

An initial inspection of the turf, as per Step 1, will reveal a lot about fibre wear. To understand the rate of fibre wear and what is causing fibre wear then a closer inspection and measurements are needed.

- Pile height and pile length are not the same thing, but both are important:
  - Pile length is the maximum length of fibre above the carpet backing.
  - Pile height is the maximum height that pile reaches above the backing.
- To measure pile length, extract a tuft from the backing material (you might need small scissors to do this – make sure you cut right down at the backing material though) flatten the fibre, measure its length and record it on the Field Survey Form.

To measure pile height, you need to measure in the pitch – it is difficult to do accurately in the field because of the infill. A useful tip is to purchase a tyre-tread depth gauge from a motoring supplies shop (Fig. 12) – simply insert the tip until it reaches the backing and read off the height.

- When you measure pile height, you should also measure infill depth (see Step 4 below).
- You need to get a reference. Ideally preserve an off-cut from when the pitch is installed and keep it in the office (it doesn't need to be any bigger than a mouse-mat). Alternatively if this is not possible – go to the edge of the pitch at the sideline furthest from the pitch entrance first. This should be the least-worn area and will give you your best reference point.
- When you are measuring the fibre it is an ideal time to note and record:
  [Tip: a hand lens or magnifying glass is useful when doing this.]
  - Fibre shape – is it straight, curled or bent over? If it is curled that might be ok – many fibres are curled naturally – look at your reference sample. If the sample is bending then it could be on its way to being permanently bent and capped – you might need to top up your infill with sand of the same specification / particle size distribution (PSD). If the carpet fibre is permanently bent then it is capped – as a minimum, power brushing will be required to address this problem. Again consider topping up the infill with sand of the same specification / PSD.
  - Fibre wear – are the ends frayed (fibrillated) or are they splitting? Do they look as though they have been cut by a blunt mower? If so this shows signs of wear – check that maintenance hours are sufficient for the hours of use (see below). Fibres will wear in time but if you are observing this early in your warranty period you should contact your supplier immediately.
  - Fibre stability – is the fibre pulling out from the backing easily? If this is happening early in the lifecycle then it could be a manufacturing problem – contact your supplier immediately.
- Research has shown that pitch performance can vary a lot across a single pitch[4] so it's important to inspect the fibre at a number of locations. We suggest:
  - The goal mouth (at both ends)
  - The centre circle/spot
  - The top of the D (at both ends)
  - Penalty spots
  - The short corner marks (at both ends)
  - Somewhere on the wings (at both ends)
  - Somewhere in the middle of the pitch
  - On the edge of the pitch beyond the touchline furthest from the gateway

Fig. 12. Tyre-tread depth gauge
You can use this to measure pile height and infill depth in the pitch.

Step 4: Infill depth

In the same way that fibre wear varies spatially, so will infill depth unless regular brushing is taking place.

- Measure infill depth when you measure pile height – you can use a tyre-tread depth gauge to measure infill height. Simply insert the point into the infill until it reaches the backing, then measure off the height.

[4] Severn, K.; Young, C.; Fleming, P.; James, I.T. (2007) The Play Performance of Six water based Field Hockey Pitches: Spatial and Temporal Changes. In: Proceedings of the Science Technology and Research into Sports Surfaces (STARSS 2007). Fleming et al. eds. September 2007, Loughborough UK. 19 pp.

Step 5: Calculate the fibre length – infill depth difference *The fibre length – infill depth difference is a critical indicator for maintenance. It will indicate whether you have sufficient or even excess infill in the carpet.*
• Simply take the infill depth away from the fibre length (not fibre height). • Your target difference should be between 1-2 mm (but allow for your accuracy of measurement. • A difference greater than this and you are at risk of capping from insufficient infill • A difference less than this and you are at risk of significantly reduced traction and player injury (see Fig. 7).
Step 6: Infill contamination assessment *This is another critical performance parameter. Infill contamination must be kept to a minimum to ensure good drainage and playing performance. By measuring the amount of contamination you will be able to establish the current situation and track the effectiveness of your maintenance system.*
• We have developed a method that you can use with simple items to be found around the grounds sheds, in the kitchen – or even better the chemistry labs if you are in a school. • Details of the method are at the end of this document. • An interactive version of the method, talking you through the various steps is also available online at www.cranfield.ac.uk/sas/sst

Scheduling by hours of use and budget accordingly

In a survey of pitch use, the average hours of use was 2000 per year. But the range was from only 450 h/yr up to 4,200 h/yr. The same survey revealed that managers did not increase their maintenance with increasing hours of use. But why not? Would you service a mower at the same interval as another mower that was used 10 times less? Or if you did 40,000 miles a year in your car, would you expect it to wear at the same rate as if you only did 4,000? It just doesn't make sense does it? Maintenance should be on a 'per hours of use, per annum' basis.

Typically, pitches managed by local authorities and state schools have a significantly higher number of hours of pitch use compared to independent schools and private clubs. Our research showed that an increase in the number of hours of pitch use significantly increases the concentration of contamination within the infill.

So how many hours a year is your pitch used? You can calculate this using Table 1. A quick tot-up will reveal all – have a look at the last year – look at the bookings sheet, fixture cards, lesson plans etc and fill in the table. If you total up rows A to E, then you will start to get an idea of the total hours of use. Also total up the hours of maintenance that you did last year. How does that ratio of usage (T) to maintenance (M) compare? Look for 10:1 – significantly higher than this (e.g. 20:1) and problems could start to occur.

Table 1 Annual hours of use and maintenance calculator.

Usage	Example Hours	Your Hours	
Internal practice (including lessons in schools)	800		A
Internal match play	200		B
External practice / short form	600		C
External full match play	100		D
Recreational use /Other	50		E
Total hours of use	1,750		T
Maintenance hours	150		M

Of course this method does start to raise questions, such as 'Is an hour of use by children the same as 30 minutes by adults?' But it will give you an indication of whether or not your maintenance is going to keep up with your usage.

The following maintenance recommendations are all based on the average 2,000 h/yr usage – but not all maintenance actions are scalable by use – it doesn't matter how much you use your pitch, if you have leaves all over it, it will become contaminated quickly, for example. This is a basic recommendation for an average pitch in a typical operation – it does not represent the maximum ideal that larger budgets could afford. For all the recommendations we indicate a frequency (weekly, quarterly, annually etc) and also where it should be scaled upwards on a per-hours-of-use basis. Note that these are minimum recommendations, they should not be scaled downwards – for pitches with very low usage infill contamination can be accelerated by lack of player wear.

A typical schedule (for a pitch being used 2000 h/yr)

Frequency	Task
Every 1-2 days	Empty bins
	Sweep pitch*
Weekly	Drag brush
	Inspect for damage
Every 2-4 months	Standard power Brush
Every 3-4 years	Deep power brush
Every 5-10 years	Infill jetting and replacement

The frequency of pitch sweeping depends on the method – measure pile height frequently to ensure that brushing/sweeping does not accelerate fibre wear.

The schedule in detail

Keeping the pitch tidy

Good housekeeping will limit contamination of the pitch at source. Again, prevention is better than cure. It is a lot easier and cheaper to remove debris and leaves from the surface than when they are particulates at 10 mm depth in the infill. These are routine processes and are most effectively done in-house.

Task	*Frequency*	*Notes*
Empty bins and clear litter	Daily	Overflowing bins will lead to excess litter and infill contamination. Think about bin capacity carefully – if staff can't empty a bin over the weekend, is it big enough to cope with a weekend of litter?
Sweep the pitch to remove debris	Every 1-3 days depending on usage	This is not to be confused with drag brushing. Sweeping devices will lift and collect surface debris to limit accumulation of infill contamination. Tractor pulled devices or hand blowers/sweepers can be used – depending on the area being maintained. Frequency depends on environment, time of year and usage. If the pitch has been used – then litter will have been dropped. Leaf fall is a bigger problem in Autumn than Spring etc.
Inspect equipment	Daily	Have a look at goals, high wear areas, gateways, stored pitch furniture etc. Look for signs of damage and wear. Spotting them early can save money and pitches.

Keep the drainage functioning

Task	*Frequency*	*Notes*
Clear surface drains of debris	Daily	Prevent litter, leaves and soil from covering surface / runoff drains and keep channels clear.
Inspect outfall and drainage channels	Monthly	Inspect the drainage outfall routinely – whether you are experiencing problems or not. Prevention is better than cure and silt traps should be emptied before they cause a drainage problem.
Rod drains	As necessary / annually	Most good quality installations will have rodding eyes and inspection points for drainage – use them. Frequency will depend on location. Accumulation rates of silt etc. in drainage pipes depends on pitch specification and construction, soils, other maintenance practices etc, rainfall etc. Again prevention is better than cure – inspect frequently and rod regularly.

Keeping the infill depth even

Drag brushing is a basic process that is used to keep the sand infill evenly distributed across the pitch. It does not clean the infill. This is a routine process and is most effectively done in-house or by using a regular contractor with the correct equipment.

Task	*Frequency*	*Notes*
Topping-up	Weekly	Top up thin areas in high wear areas with identical infill sand. Don't be tempted to buy cheaper sand. If you get the wrong particle size distribution it can play havoc. Also research at Cranfield has shown that the wear rates using sharp (non-rounded) sands are significantly greater. Never use sharp sands.
Drag brushing	Weekly (1,000-2,000 h/yr)	Think about drag brushing in the same way you think about mowing a natural turf pitch (except that you need to do it regularly all year round).
	Twice weekly (3,000-4,000 h/yr)	Regular drag brushing evens sand infill and reduces fibre capping – keeping playing performance up and consistent across the pitch. There's a vast range of drag brushing equipment on the market. Look for brushes that: • Are big enough to do the job and do it quickly – but 'agile' enough to be turned. • Are designed for the type and length of fibre for your pitch • Will not damage fibre A good brush will cost ~ £1000. Of course if you don't have a tractor to pull it, you will need to account for that too. A standard size hockey pitch should take 60 – 70 minutes to brush. Remember to change the direction you brush in to avoid nap! For brushing patterns, think Union Jack, not Stars and Stripes. Be careful not to damage seams and lines though.

Cleaning the infill

Sweeping and drag brushing only slow the rate of contamination – they do not eradicate it. To clean the infill other maintenance techniques are needed. The general principle is that infill is either: removed, filtered and returned; or removed and replaced with new infill.

Different techniques are effective to different depths. As a rule of thumb – the deeper you go, the longer it will take and the more it will cost. In fact, costs increase exponentially with depth!

Task	*Frequency*	*Notes*
Standard power brushing	Every 4 months (2,000 hr/yr) Every 3 months (3,000 hr/yr)	A contra-rotating brush (rotated in the opposite direction to your forward movement) is used to lift the infill over a set of metal sieves, finer material is removed and the sand falls back and is luted in by a trailing drag mat or drag brush. You might hear this called 'Renovation' – it's the same thing. Some manufacturers claim a 5 mm working depth but in our field tests we measured working depth to be 2–3 mm. Effectiveness was 14% in our field tests (i.e. within that 2-3 mm, it only removes 14% of infill contamination present). That was for a system filtering the sand. Unfiltered systems will be lower The infill must be dry when doing this – effectiveness drops significantly if the infill is wet. At 10% moisture content the effective working depth is reduced by up to 60%. Also, the filtering process is less effective as fines will adhere to the sand infill particles. Routinely measure pile height to ensure that brushing frequency is not excessive and causing pile wear. Think of it as 'powered grooming' more than 'cleaning'. By lifting the top of the infill it breaks up any caps, and brushes fibres upright. This will improve playing and drainage performance. Note that contamination will continue to accumulate below this depth as the rest of the infill will not be affected by the brushing action. A 'contamination pan' can form below the brush depth. A specialist contractor will charge £300-£500 /pitch to perform this task. An in house solution would be an equipment cost of ~£15,000 (although non-filtering, tractor PTO powered brushes might cost less), plus labour and overheads. The process takes 2-3 hours. Cost effectiveness will depend on the number of pitches and your annual hours of use. If you are a high hours user and you have 2 or more pitches then an in-house solution might work.

Deep power brushing	Every 3 years (2000 h/yr)	This technique also uses a contra-rotating brush but works at 7-8 mm depth. You might hear this called 'Revitalisation'. The removed infill is filtered and returned to the surface and the levels topped up with new infill. Effectiveness was 23% in our field tests. We recommend that you check whether you need it or not by using our infill contamination test. Laboratory studies at Cranfield have shown that there is a risk of fibre tip damage from the polypropylene brushes used in this process as these depths. However this risk is at a 4 passes a year in new fibre. It is not recommended to perform this process at this frequency (it's just not economic) but some sites do carry this out on an annual basis – particular attention should be paid to older carpets where UV-aged fibres could be more susceptible to this type of wear. Again, the infill must be dry when doing this – effectiveness drops significantly if the infill is wet. This is normally a specialist maintenance contractor job. They will use 2-3 machines to do the job in a day and cost is usually £3,000-£6000 depending on the type and number of machines used If you did want to do it in house, equipment would cost up to £30,000 per machine and it will take approximately 2 – 3 days to complete using only that machine!

Infill replacement

These are 'once in a lifecycle' (hopefully) treatments that remove the entire infill, for replacement with cleaned or new infill. Because of the energy, work rates and materials involved – these processes are costly. They should only be considered as emergency recovery when something has gone wrong and pitches can't be used due to persistent flooding and dangerous conditions under foot. They are not as cost-effective as routine maintenance. (These processes are sometimes called 'Rejuvenation'.)

Task	*Frequency*	*Notes*
Air jetting	Emergency as needed	Sand infill is removed by compressed air and has a typical working depth of up to 16 mm. The compressed air process is effective on both short (12 mm, usually sand-dressed) and long pile (23 mm, sand-filled) 2G carpet types. Effectiveness in our field tests was 90%. Costs vary, depending on the technique used, the type of sand needed to replace removed infill (always match your replacement to your original sand) and whether waste material needs to be removed from site. Costs can be in the range of £15,000-30,000 for a contractor to remove the infill and replace it with new material. It takes about a week to complete – so the pitch will be out of action.
Water jetting	Emergency as needed	The compressed water process is effective on short pile, sand dressed 2G carpets. Effectiveness was 90% using new infill replacement. In longer pile carpets (more than 15 mm, sand filled) efficiency was less than 20%. When using pressurised water, particularly on longer (more than 15 mm) pile carpets, make sure that contamination is not pushed downwards through the profile or washed across the pitch to other areas or drains – you will just be moving the problem about, not solving it.

Important notes on infill cleaning and replacement

Only infill replacement removes all of the contamination from the infill. Standard and deep power brushing have only a marginal effect on contamination and you could still end up with a 'contamination pan' or contaminated layer impeding drainage below the working depth of these machines.

These techniques do help to groom the fibre, break up surface capped infill and increase porosity and infiltration rate if used regularly (but at frequencies that do not damage your pitch).

Research has shown that the processes used during maintenance do not cause any significant wear to the synthetic turf surface provided that the number of passes does not exceed that above. It is essential that the surface is regularly checked for tears and seam failure as the brushing action may cause further damage by exerting strain on the damaged carpet. Also you must consult your warranty documents and any advice on maintenance provided by your supplier to ensure these techniques are compatible with your surface.

'As and when' Maintenance

Task	*Frequency*	*Notes*
Changing pitch equipment		Try not to drag heavy, angular equipment across the carpet – use appropriate wheels etc. where possible. Make sure goals in use and in storage are properly secured. Built in, recessed equipment storage areas are a good design feature in a pitch – speak to your consultant at the design stage for any new pitch.
Seam repair		Seam repair is a specialist operation, requiring specialist materials – consider getting a contractor to do it or contact your original installer/supplier.
Patch repair		Patch repair is possible, again it is a specialist process (see Seam Repair above). Be careful that you match your patch to the surrounding turf. In our research we observed one pitch where there was a threefold increase in traction in a patched area compared to the surrounding pitch. This usually happens in older pitches because there is a large contrast with the new fibre in the patch. A localised three-fold increase in traction is a potential injury risk to players – take care to ensure high quality of repair and player awareness.
Chewing gum removal		Specialist products are available – contact your grounds-care supplier for suitable products for use on synthetic turf pitches and follow instructions.
Moss and algae removal		This can be done by a combination of power brushing and/or spraying. Spray as a last resort. Synthetic turf pitches have very high hydraulic conductivities and low chemical retention – there is a high risk of pesticides reaching drainage outfall and polluting watercourses. If you have a qualified staff member to do spraying in-house then select the appropriate on-label product and follow the label guidelines and standard COSHH/PPE/SHE procedures. Otherwise get a qualified experienced contractor in. A prophylactic approach (spray routinely just in case you might get moss/algae) is not appropriate for synthetic turf – it is not cost effective and it increases the risk of pesticide pollution of watercourses. You should only begin to spray when you see a problem appearing. Spraying should then only take place whilst the problem persists or the risk of the problem persists. Remove the problem at source – get the pitch drainage working again (see above) and get the infill clean – otherwise it will be a vicious circle.
Line marking		Some pitches do not have lines cut in but allow groundstaff to add lines as necessary. Equipment and line-marking materials are available for this – speak to your supplier. Make sure that the paint you use is suitable for your synthetic turf. It goes without saying that you need to routinely inspect lines to ensure that they are visible to players and appropriate for the sport being played.

Key summary points

1. Design your pitch to avoid maintenance problems
2. Plan to maintain from Day 1.
3. Keep to the 10:1 – usage : maintenance ratio
4. Keep infill levels topped up and prevent capping and poor playing quality
5. Keep infill clean so that through-pitch drainage works
6. Keep a regular eye on your pitch so that problems don't get out of hand
7. Engage and inform your users on how they can look after their pitch
8. Have a go at the Pitch Condition and Maintenance Audit – how well are you doing?

Contacts and further information

Centre for Sports Surface Technology Cranfield University:
The Centre for Sports Surface Technology at Cranfield University provides research and consultancy in the design, operation and performance of sports surfaces. This includes the research used to develop these guidelines and other work for community sport such as guidelines on drainage, irrigation and even the preparation of cricket pitches. Visit the website to download for free.

The website also provides on-line tutorial videos and other resources such as methods and other publications of interest. Visit **www.cranfield.ac.uk/sas/sst**

The Institute of Groundsmanship (IOG):
Is a membership organisation representing the grounds-care industry and all those involved in it. They supply information and training, including a specific course on Synthetic Turf Maintenance. Visit **www.iog.org**

About the Cranfield University – IOG 'Maintaining Synthetic Turf' Project'

The project started in 2003. It was funded by a £40,000 grant from the IOG 2012 fund, and the government's Engineering and Physical Sciences Research Council with the clear aim of developing a set of guidelines for the IOG Membership and the industry on how to maintain synthetic turf pitches.

The research was Andy McLeod's Engineering Doctorate thesis, which is available to read on-line at www.cranfield.ac.uk/sas/sst where you can also find details of academic papers published on this subject.

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Since completing this research project with Cranfield University, Dr Andy McLeod is now working as a consultant and can be contacted at: Total Turf Solutions Ltd, PO BOX 250, Northampton, NN5 5WZ, UK. Tel: +44 (0) 1604 750555 am@totalturfsolutions.co.uk

Pitch Condition and Maintenance Audit

Pitch Condition Survey

Pitch Location	**Date** __ / __ /20__
Pitch number	
Inspected by	**Time**

General Survey		**Location of problem and notes**
Standing water	Yes/No	
Litter?	Yes/No	
Muddy areas?	Yes/No	
Worn turf?	Yes/No	
New areas of worn turf?	Yes/No	
Split seams?	Yes/No	
Fencing intact?	Yes/No	
Gates functioning?	Yes/No	
Kick boards ok?	Yes/No	
Bins ok?	Yes/No	
Bins being emptied?	Yes/No	
Signage in place?	Yes/No	
Check following areas are ok:	Yes/No	
Goal mouths	Yes/No	
D's / 6-yd boxes	Yes/No	
Penalty spots	Yes/No	
Top of D's	Yes/No	

Continued over leaf

Check following areas are ok:	Yes/No	
Short corner marks	Yes/No	
Centres	Yes/No	
Wings	Yes/No	
Pitch edges and Curbs ok?	Yes/No	
Touchlines ok?	Yes/No	
Run-off areas clear?	Yes/No	
Run-off areas clean?	Yes/No	
Pitch uneven / Carpet rucked?	Yes/No	
Pitch hard / soft in places?	Yes/No	
Pitch equipment	Yes/No	
Goal frames ok?	Yes/No	
Goal nets ok?	Yes/No	
Equipment tidy & secure?	Yes/No	

Drainage		**Notes**
Surface drains clear	Yes/No	
Inspection chambers clear?	Yes/No	
Depth of silt in silt traps	Yes/No	
Outfall clear?	Yes/No	
Drains last rodded:	__ / __ /20__	

Fibre and Infill

(Norm = Normal, Splt = split, Fib = Fibrillated)

	Fibre shape	Fibre wear	Fibre Stability	Fibre Height [mm]	Fibre length (LF) [mm]	Infill depth (DI) [mm]	LF-DI [mm]
Goal mouth 1	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Goal mouth 2	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Centre circle/Spot	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Top of D's	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Penalty spots	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Short-corner marks	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Wing 1	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Wing 2	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Wing 3	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Wing 4	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Half 1	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Half 2	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Pitch edge	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Gateway	Norm / Bent / Capped	Norm / Splt /Fib	Good/Poor				
Areas of concern							
Action needed							
Action taken							

Maintenance Audit

Question		Answer
A. How often do you do the following?		
	Empty the litter bins?	
	Sweep around the pitch (fence corners etc)?	
	Sweep the pitch	
	Drag brush the pitch	
	Power brush the pitch	
	Deep power brush the pitch	
	Top up the infill	
	Inspect the drainage system	
	Clean the drainage system	
B. Have you ever replaced the entire infill		YES/NO
	If YES, why?	
C. When was the last time you did the following?		
	Swept the pitch	
	Drag brushed	
	Power brushed	
	Emptied the bins	
D. Which of the following equipment do you have?		
	Drag brush	
	Pitch sweeper	
	Leaf blower	
	Power brush	
E. Do you use a maintenance contractor?		YES/NO
	If YES, when was their last visit?	
F. How many hours per month do you spend doing the following?		
	Sweeping the pitch	
	Drag brushing the pitch	
	Power brushing the pitch	
G. What is the total hours of maintenance per year? (Add up answers to F. and multiply by 12)		
H. How often do you do inspect the pitch?		
I. What was the original infill specification?		
J. What was the original pile length?		

Maintenance audit (Follow-up)

Question A: How often do you do the following…?
This question asks you to consider the frequency of the various operations listed. Compare this frequency to the frequencies suggested in Part 2 of this guide. Is it sufficient, given the amount of use your pitch gets? Have you had a close look at your pitch to determine this? If the answer is no – do a pitch survey like the one suggested above.

Question B: Have you ever replaced the entire infill?
If the answer is no, and you've done an infill contamination assessment, which shows less than 5% contamination then you are ok. If you are in the region of 5-10% then you could be heading towards infill replacement – monitor infill contamination carefully.

If the answer is yes, then you will know all about the cost of doing so. Why did you need to do it? Was it a drainage problem caused by contaminated infill? Have you adjusted your maintenance system so that it will not happen again? Again you should monitor your infill contamination frequently and watch out for a trend of increasing contamination – and act accordingly to prevent.

Question C: When was the last time you did the following?
This question gets you to think about whether your maintenance schedule has slipped. Is it as well looked after as it was when it was new? Have budgets tightened since installation? Have you found looking after the pitch more expensive than you thought /were told it would be?

Be careful – if your maintenance is not sufficient for your usage, then you could be shortening the lifecycle of your pitch. This has direct financial consequences that far out-weigh the ongoing savings from cutting back on maintenance (see Part A).

Question D: Which of the following equipment do you have?
If you have all four then you are well set up for maintaining a synthetic turf pitch – be careful not to over power brush though – inspect the tips of your fibres carefully and compare to your reference sample.

If you have the first two only and you contract your power brushing then that is fine. Sweeping equipment and a drag-brush are the minimum requirements for operating a synthetic turf pitch effectively (as long as the other operations are contracted in). A leaf blower might be necessary, depending on surrounding trees etc.

Question E: Do you use a maintenance contractor?
This will depend on your operating approach but knowing when to contract and when to do in-house is not only a financial decision – it will depend on the frequency of the job too. You will need someone to be inspecting and tidying the pitch frequently – contractors are not necessarily well positioned to do this.

The second part of the question is a prompt to ensure that if you are operating by contracting out your maintenance, that this hasn't slipped to the detriment of your pitch.

Question F: How many hours per month do you spend doing the following? and
Question G: What is the total hours of maintenance per year?

This is all about the total hours of maintenance. Add these up and put them in the Schedule of Hours of Use – is the ratio 10:1, usage:maintenance?

Question H: How often do you do inspect the pitch?
This needs to be frequent too – an annual inspection like the Pitch Condition Survey is important but daily-weekly inspections of tidiness, pitch functioning and looking out for problems is essential.

Question I: How often do you do inspect the pitch?
If you know this, then you know what to top up with. If you don't know this, then speak to your installer or ask a specialist consultant to help choose a suitable product.

Question H: How often do you do inspect the pitch?
If you don't know, the closest thing to it on the pitch will be against the curb on the far side of the pitch from the main gate, i.e. your lowest wear area.

Cranfield Infill Contamination Assessment Method

What you need

3 x see-through cylinder / tube about 50 mm diameter minimum 300 mm long (look in the supermarket they are often used as packaging – also used for posters etc)

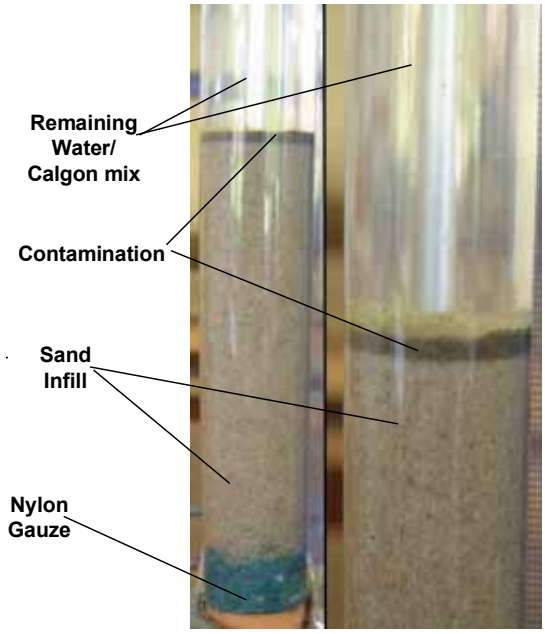
1 x Calgon tablet (as in 'Washing Machines live longer…')

3 L of water

2 x drop of washing up liquid

300 g of infill

1 x bucket (> 3L)



Taking the sample

You need to sample from across the pitch (although if you have a particular problem area you should look at this separately and compare results with the rest of the pitch. Extracting the sample is difficult as you need to get all the infill out from right down to the bottom of the pile – without damaging the pile. Hair combs are useful for this – make sure you get it all up though – including the contamination. Scrape it into a bag and take it to your 'lab'.

Method

1. Mix the water, the Calgon, bicarbonate of soda and washing up liquid into a solution until it's all dissolved.
2. Add one third of the solution to each cylinder.
3. Add one third of the sample to each cylinder and stir well.
4. Allow to settle over night.
5. Record the depth of contamination to the nearest millimetre.
6. Record the depth of infill sand to the nearest millimetre.

Calculating the Results

1. Calculate the percentage contamination as follows for each replicate:

$$\text{Contamination}\,(\%) = \frac{\text{Depth of Contamination}}{\text{Depth of Infill Sand}} \times 100$$

2. Average the three results as follows:

$$\text{Average Contamination}\,(\%) = \frac{\text{Contamination}\,1 + \text{Contamination}\,2 + \text{Contamination}\,3}{3} \times 100$$

Your average result can then be used to monitor performance of your maintenance and to allow you to use it as a decision making tool

Health and Safety

Do not drink the solutions or mixtures. Wash your hands thoroughly and use suitable PPE. Dispose of all chemicals and wastes in accordance with best waste disposal practice.