Natural Turf

Guidance notes on the construction, maintenance and performance of natural turf pitches
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One of the most enjoyable aspects of my position as CEO of the Football Association of Ireland is the opportunity it gives me to visit local communities and to witness the remarkable achievements in providing quality football facilities. I know that many years of planning and hard work have gone into these ventures.

The pathway to develop these facilities can be long and arduous but there is assistance available through the Department of Arts, Sport and Tourism and from the Football Association of Ireland's Facility Development Unit. Therefore, I am delighted to support the development and distribution of this, the latest in the FAI’s series of guidance notes for clubs, leagues and facility operators.

I would like to take this opportunity to thank you for the work undertaken or about to be undertaken by you and hope that you find that these guidance notes assist you in maximising the quality of your facility as well as delivering value for money.

John Delaney
This guidance note has been developed in order to help clubs affiliated to the Football Association of Ireland in the development and management of natural turf pitches. If football in Ireland is to be developed to its full potential, it needs to take place on good quality surfaces that are available for use whenever required. Although the development of synthetic turf pitches has improved in recent times, players desire for the competitive game to be played on natural turf still outweighs that of synthetic turf.

When planning the improvement of existing pitches, it is essential to identify the problem correctly in a methodical approach to prescribe the correct solution. Often, problems on a pitch surface are a direct result of over usage, lack of maintenance and absence of a yearly renovation/maintenance programme, all of which can be altered.

On proposed new natural turf pitch development projects, consideration of all implications and approaches suitable for the site need to be explored. Failure to consider all aspects of the development in sufficient detail may result in delays, additional costs and potentially a poorer surface to play the game on. In the longer term this may also discourage users and potentially increase maintenance costs and reduce usage levels.

While this document provides guidance on the design, construction and maintenance of playing surfaces. It is essential that except for the smallest projects advice must be sought from qualified and experienced personnel with a proven knowledge of sportsturf. A checklist for the engagement of such professionals is provided in Appendix C. Appropriate planning, design, management and maintenance are crucial to the success of any natural turf surface. Further information is available from The Sports Turf Research Institute on www.stri.ie.
2.0 Conditions on natural turf pitches in Ireland

2.1 FAI eircom League of Ireland pitch assessments 2007

In the spring of 2007, natural turf surfaces for football performed poorly due to the driest spring season on record. The Sports Turf Research Institute were commissioned by the FAI to carry out an assessment of playing facilities. Further to this, a report was sent back to both the club and the FAI on the issues found on a site by site basis with site specific recommendations and overall strategic recommendations. The main findings of the studies included the following;

- Some pitches needed complete reconstruction due to irregularity in levels, heavy clay topsoils, drainage issues and poor swards
- Intensive maintenance programmes needed to be put in place to deal with the level of fixtures being proposed for facilities.
- Many clubs struggled financially with even the simplest of maintenance tasks
- Due to the playing calendar, pitches did not have an adequate rest period for a spring renovation
- There was a lack of adequate irrigation systems on pitches
- A need for training tailored for Irish conditions was identified
- The need for development construction and maintenance guidelines was established

2.2 Climate change and its affect on pitch performance

The effects of climate change in Ireland may have considerable consequences for turfgrass. Higher rainfall events in shorter periods of time followed by longer dry periods mean pitches have to be designed and constructed to improve drainage in such conditions and yet retain moisture when needed. Water sourcing for irrigation and indeed efficient systems of application of water also need to be considered. With unpredictable extremes of weather annual maintenance and renovation of pitches is also becoming more difficult. Strategically, the FAI is providing assistance to clubs in dealing with these issues by;

- Recommending that a staged process of decision making be adapted for all new and existing natural turf improvement projects.
- Ensuring that only the use of proven methodologies and advice are to be used in the construction of new pitches, drainage systems and irrigation systems
- The development of more facilities to deal with the increase in participation in football in Ireland
3.1 User needs analysis

Before embarking on any project, clubs should collect some simple factual information internally at an early stage in terms of what their needs and desired deliverables are for the proposed project. Such information should be gathered before engagement of consultants or initiating the development of a natural turf playing field. This information should include;

- The sports played or to be played on a week by week basis. This should include for the sharing of facilities with other sports. Use table below.

- Expected level of competition (e.g. eircom league versus other FAI affiliated leagues)

- Expected number of teams to use the new facility in terms of hours of usage (note senior and junior teams should be segregated)

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<th>Activity</th>
<th>Anticipated Weekly usage</th>
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<td></td>
<td>Adult Play</td>
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- Expected levels of usage in terms of teams, training sessions and matches at various times of the year; this is best broken down into seasonal usage levels.

- The need for floodlighting for the facility; if a facility is floodlit it is likely that relatively high usage levels are expected in winter and this should be considered.

- The need for phased developments of the facility; phased development needs to be identified at an early stage and it is generally determined by funds available.

- Resources in terms of equipment and staff that will be available to maintain the new facility; a realistic approach needs to be taken to determine if resources will be available for maintaining the new facility.

- Potential funding sources available and potential budget
3.2 Technical Feasibility Study

For all but the smallest of projects a feasibility study should be carried out by a competent consultant. Clubs should use the notes in Appendix C to aid the appointment of a consultant. The cost of professional services is a relatively small part of your overall project cost and it can be included in your budget costs when seeking funding through grant schemes.

In the majority of cases where earthworks or considerable drainage is needed, a site topographical survey is required. The survey should be provided in both hard and electronic copy to the club. The consultant should use this in the delivery of the feasibility study which should cover the following issues:

- Location and pitch layout assessment; access for emergency services, correct aspect and layout in terms of positioning, adequate safety margins, runoffs etc., account for spectator viewing, proximity to other objects such as trees and surrounding banks and maintenance access.

- Soil profile pits and topsoil texture analysis carried out by an approved A2LA Turfgrass Laboratory; this will help to determine the extent of drainage needed on the site. Subsoil conditions and identification of issues with stones or rock must also be considered. On new sites these should exceed the full depth of likely excavations. Excavations should be referenced to soil and geology maps.

- Drainage discharge points and consent issues; potential drainage discharge points need to be assessed and qualified. Drainage outfalls must be lower than any proposed pitch drainage system, taking into account a minimum of 1:200 fall on pipes. Drainage consent issues as well as potential ecological issues also need to be addressed.

- Services on site such as electricity, gas, existing drainage etc; these items need to be identified to allow for alteration in future design. A full services survey can be carried out at a later date but initially, visible and reported buried services should be marked and commented on.

- Definition of the requirements in terms of usage levels; this information will be taken from the strategic planning stage. If the proposal is to upgrade an existing pitch the condition of the pitch in relation to usage levels needs to be referenced.

- Identification of potential constraints in the development which could cause technical or financial problems.

- Local weather; meteorological data needs to be assessed to quantify local weather patterns and the need for irrigation and drainage.
• Current maintenance practices; if the pitch is currently in use and proposed for upgrade a critical assessment of maintenance equipment and procedures needs to be carried out. If the pitch is a new field site, it may be useful to visit the clubs existing ground and cross reference maintenance quality.

• Contours; assessment of site contours from topographic survey and the need for levels adjustment.

• Recommendations; technical approaches to be used including pitch soil profile build, drainage type and irrigation requirements.

• Likely budget costs and cash flow needs of the approach recommended; this is the figure that the club would propose to apply for in grant aid.

• Identification of timelines for the construction, grow in and when the facility will be available for use.

• Future maintenance needs and input requirements and associated costs.

Following consideration of these issues the feasibility study together with any other documentation should be sent to the Facilities Development Unit within the FAI for approval. With consent, the club should then send the study along with any other documentation to the grant aiding authority.
It is necessary to ensure that the design for pitch development and improvement works are suited to the site and will achieve the desired deliverables. Approaches to achieving this are outlined below.

4.1 Design Approaches

Design and build approach
This involves the development of a design brief stating the design requirements for each contractor to meet. The contractor then submits a full design, specification and priced bill of quantities for the proposed works. This approach relies heavily on the contractors experience in pitch design and in particular the design and build approach. It can be difficult to compare like with like proposals at procurement stage, therefore it is essential that a design brief is accurate. A consultant can be used for this task (see Appendix C). Hence, this approach should only be used for smaller upgrading projects rather than new pitch builds or large drainage schemes.

Design specific approach
The majority of new natural turf pitch developments require a site specifically designed drainage and soil profile system to ensure satisfactory playing conditions throughout the season. The consultants design approach should be within those described later but also should follow basic design principles. The procurement document should include;

- conditions of contract
- specifications for works
- quality assurance needs
- bills of quantities
- Specific scaled CAD drawings.

4.2 Design issues in pitch development

Basic design principles must be followed in the development of natural turf pitches for football in Ireland. Crossfalls on finished pitches should be no steeper than 1:80 – 1:100 along the line of play and 1:50-1:60 across the line of play. All drainage systems should be designed to cope with a 1 in 50 year storm (calculations should be carried out) and in general should be laid at a maximum fall of 1:200. A drainage layout should be designed to intercept water flow rather than run with the fall of ground. A minimum cover of 500mm over the invert of pipes is necessary to allow aeration activities in future. Drainage should be installed with adequate positive outfall and calculated pipe sizes to prevent over engineering.

Levels adjustment
For minor level changes (+– 50 mm), cultivation and grading within the soil profile may be acceptable. Where greater earthworks are needed a cut and fill approach is generally prescribed. This involves stripping and storing the topsoil to an ‘off the pitch’ area and removing “cut” from the high areas and placing it as “fill” in the lower areas. Such operations can lead to settlement, so strict design principles need to be applied to prevent this.
Undrained pitches

Even with free draining soils, there are few situations where undrained pitches provide a sustainable year round playing surface. In some cases where sandy soils overly gravel, limestone and chalk there have been exceptions.
4.3 Different Design Methods

Pipe drained pitches

This is the most popular approach to pitch drainage and construction. Depending on the quality of the soil and the usage levels proposed, pipe drains are installed at 2-5 metre spacing, with inverts about 450-600 mm below the surface at a constant 1:200 fall. A positive outfall must also be provided with drainage consent provided.

The trenches are backfilled with porous gravel material of high percolation rate for effective drainage. This is filled to within 200mm of the surface, followed in some cases by a 50mm layer of blinding grit to prevent movement of fine material into the drain. The rest of the trench is backfilled to ground level using a specified rootzone. A thin layer of sand is worked into the surface to prevent soil from smearing and provide a firmer surface layer. From a maintenance point of view, this type of pitch will require aeration and repeated sand top dressings. The selection of these materials is a specialist process as all the layers must interact correctly to perform (see Appendix A).
Pipe and Slit drained pitches

Supplementary slit drainage will greatly improve the performance of a pipe drained pitch. If the slit drainage system is installed correctly, the slit should intercept water on the surface and carry it through a further series of narrow slits to connect with the porous material in the pipe drain backfill. Slit drainage systems generally involve one of the following:

- A series of 50mm wide excavated trenches backfilled with a combination of gravel to within 100mm of the surface followed by a carefully selected coarse sand.
- A series of sand bands, generally 30mm wide, cut through the soil profile and backfilled with suitable sand.

Heavy sand topdressings (about 100 tonnes) of approved sand are essential for the success of pipe and slit drained pitches. In heavy clay soils, shrinkage and settlement may occur on slit drained pitches. Sand dressings and localised top ups should be used to address this in combination with aeration.

Fig 5: Pipe and Silt Drained Pitch
4.0 Pitch Design

Sand Carpet Pitch

Typically these pitches have a combined pipe and slit drainage system installed into the existing native soil followed by a capping of 100-150mm of sand or sand dominated rootzone. The sand used on these constructions is specific and will greatly influence performance (See Appendix A). A key factor in ensuring sand carpet pitches are correctly installed means making sure no smearing occurs over the drains.

Sand must be continually applied to prevent earthworm activity reducing infiltration rates of the sand. Although these types of pitches have proven to perform well in winter, there have been reports of hardness issues and drainage problems in dry weather. Sand carpet pitches are also high maintenance in terms of nutrients and water and need intensive aeration and sanding programmes to prevent them from capping over. In most cases for summer use, an automatic pop up irrigation system would be recommended.
Soil over drainage layer

This approach involves installation of a drainage system at 5-10 metre centres in the subgrade followed by the spreading of a 100mm deep layer of 6-10mm gravel. A 50mm blinding layer of grit is then applied over which 180 mm of soil is placed. After an amelioration of 20mm of specified sand is put into the surface, a series of gravel bands are cut through the surface at 250mm centres, connecting the surface to the porous material underneath. After a series of further sand ameliorations, the surface is seeded. In most cases an automatic pop up irrigation system would be recommended.

Fig 8: Soil over drainage layer pitch
Suspended water table rootzone pitch

With a similar base drainage and gravel layer as that outlined in the ‘soil over drainage layer’ method, 300mm of rootzone material is spread over the gravel with the blinding layer intact. The rootzone is generally a sand/soil blend with compatible sand forming the lower half of the rootzone. Selection of materials is highly critical with specific matching of gravels, sands and rootzones necessary. These pitches can be reinforced with various fibre and synthetic strands to increase usage levels and add stability when surface cover is lost. They must also have an automatic pop up irrigation system and in most stadium cases will have an undersoil heating system. These types of pitch constructions are costly to build, have relatively moderate usage levels and very high maintenance and renovation needs.
4.4 Selecting Raw Materials

Irish sands and gravels for use in pitch construction

The selection of sand and gravel for pitch construction and drainage is a specialist task, one which consultants, not contractors must be given the final say and take responsibility for. Over many years of research, it has been proven that the best sands for topdressing and soil modification on winter games pitches conform to the grading curve presented in Appendix A. The curve provides both an ideal and acceptable range envelope into which the sand analysis should be plotted. If the sand falls out of the acceptable range at any point it should not be recommended. The sand presented in the curve is a medium fine grading and there are both acceptable and ideal ranges for the sand to grade into.

Other factors to be assessed when choosing sands include particle shape and lime content. Sand sampling should be carried out initially before the material is ordered and again at delivery. Irish sands are naturally quarried and there may be variations in quality, hence a quality control procedure on delivery to site and stockpiling. Analysis should be carried out by an A2LA registered turfgrass laboratory.

Gravel samples are also subject to similar testing and quality assurance. Gravel should be free from dirt and fines and again is subject to sieve tests and various physical parameters for water movement and pore space before approval. In general, it is often easier to get locally available gravel that meets the requirements of sportsfield drainage than a good quality locally available sand. Hence, sand often has to be transported long distances.

Grass establishment is the cheapest and in most cases the best way to establish a grass sward on a new pitch. Certified seed of at least 3 cultivars rated not less than 7.0 for live ground cover and visual merit as published by the STRI and BSBP Amenity Committee handbook (www.stri.ie). In general, hard wearing, fine leaved cultivars such as perennial ryegrass are recommended for football fields. Research demonstrates that such swards have higher wear tolerance, better winter colour and overall lower input levels than other species. It is important that when pitches are seeded that adequate fertiliser and irrigation is allowed for.

Turfing is a faster but more expensive way to establish grass on a new football field. The turf should contain the same hard wearing species as above and should be approved by the consultant. The soil profile of the turf must also match the underlying profile it is being laid on and in some specialist cases, washed turf can be used. Turfed pitches often require hollowtine aeration in order to assist surface drainage and encourage rooting in the first two years.
5.0 Upgrading existing pitches

Installing pipe drainage in existing pitches
Where levels are acceptable the installation of pipe drains into existing pitches is possible. This process is generally carried out by excavating trenches (generally 3-7 metre spacing) which are backfilled with gravel as described in section 4. Modifications to this can be made to include specified green waste compost in order to provide nutrient and moisture retention for grass establishment trench without affecting drainage rates. If entire pitch over-seeding is not being carried out, drain lines should be fertilised and seeded. It should be noted that when installing pipe drainage in existing turf pitches, care must be taken not to damage the surface with heavy equipment. Particular attention should also be placed on drain gradient as existing gradients may not be adequate for drainage design. In such instances, drain lines should be laser graded. Following pipe drainage, slit drainage often follows with heavy sand topdressing with specific sand.

Installing slit drainage in existing pitches
If slit drainage systems are to be installed in pitches the integrity of the pipe drainage system to carry water away from the site must be guaranteed. Slit drainage will carry water small distances (generally 5-7 metres with a good gradient). Slit drainage is generally installed 6-8 months after pipe drainage, once a full strong cover is established on the drain runs. Hence, the improvements can be on a phased basis. When installing slit drainage, it is imperative that the integrity of the pipe drains is proven. Slit drains are usually installed at 2-5 metre centres, depending on soil type. It must be noted that slit drains mainly function to carry water down through the profile to the pipe drains and on flat ground they will not transport water long distances. Slit drains are backfilled with selected gravel to within 150mm of the surface and topped off with specified sand or rootzone. After installing slit drainage the pitch will need sand topdressing with specified sand of at least 10mm per year for the first three years.
With climate change more evident in recent times, the need for irrigation systems on pitches has become more necessary in recent times. An irrigation system also allows for faster renovations as operations are not so weather dependent. It is important to note that irrigation systems are a complex function with particular requirements and design criteria that are necessary for football pitches.

Components of an irrigation system
It is imperative to have a good water source for a successful irrigation system. This is generally from a bore hole feed but can also be a mains connection or a licensed extraction from surface water. The quality of the water proposed for irrigation should also be tested.

The source will then need to be able to provide an adequately sized draw pump to provide enough water to fill the storage tank in a set period of time. The size of the storage tank is dependent on this. The storage tank can be above or below ground.

Below the ground tanks tend to be concrete whereas above ground tanks tend to be galvanised and plastic. The tank should have enough storage to supply the system with enough water to apply 4mm per day, allowing for replenishment by the water source. Hence the system is not waiting long periods of time for replenishment of the tank.

The tank feeds the irrigation pumps which are governed by a control system. The pumps then pump water through the irrigation pipe infrastructure to the pitch where it is needed. The control system used can also control the application system, depending on the type used.

Irrigation Application System Types
In general, irrigation application systems include the following;

- Fully automated pop up sprinklers
- Perimeter pop up sprinklers and mobile centre sprinklers
- Mobile irrigators
- Stationary sprinklers from hydrant points

The type of system chosen will depend largely on local climate, budget, soil conditions, pitch usage levels and the performance expected. In most stadium scenarios with high sand content soils and extensive drainage systems, pop up sprinklers are used. In soil based pitches where irrigation is only used in emergency scenarios, mobile irrigators are more popular. In all automatic irrigation pop up systems, the design should be signed off by a competent irrigation engineer. On more basic systems, contractors should provide assurances that the system will apply the water needed in the space of time allocated.
Irrigation Application in Dry Periods

Evaporation of irrigation water is greatest from about midday to 4 pm. Irrigation at this time should be avoided. Some watering during the evening/night allows for minimum evaporation of water and will provide maximum benefit. Unfortunately, timing on systems is generally restricted to fully automatic pop up irrigation systems. Combining watering with shallow aeration or spiking/forking allows water to penetrate the grass canopy and into the soil profile where it can be used by the plant. In some pitches where organic matter and thatch have built up in the profile such operations are vital to get water penetrating the soil profile and avoiding the sponge affect of the upper layer.

This will also encourage deeper rooting of the plant, a must for plant health in drought conditions. Dry spots in high use areas such as goal mouths will probably need more water than others and hence it is always a good idea to have a source of water relatively near both goal mouths.
7.0 Pitch maintenance and renovations

7.1 Renovations

Generally, spring time is the best time of the year for renovation activities but this will vary depending on when the season ends. In the majority of cases, contractors should be engaged to carry out the majority of renovation works. Objectives to achieve should involve:

- Level adjustments, goalmouth turfing
- Turfing of high wear areas i.e. goalmouths and the penalty spot
- Sward improvements
- Soil profile improvements

Localised Levels Adjustment

Localised level adjustment may be necessary on pitches with high levels of wear such as in goalmouth areas. This can be carried out by initially cleaning up the area for levels adjustment with a scarifier or brush. A sod cutter may also be used to prepare the base of the low area by removing the sod underneath. Following this, the area should be vertidrained at high heave to help minor levels adjustment. The area should be top-dressed with a suitable sand: soil mix, at a mix of 80% specified sand and 20% sandy loam soil. A pre-seeder fertiliser application followed by seeding should be raked into the tilth. If possible, the area should be covered with a germination blanket to help improve germination conditions. The area should also be watered daily to retain adequate moisture for germination and plant growth. After the seed has germinated, the new plants will begin to grow under the blanket. At this stage, the blanket should be removed.

Turfing on Pitches

Where turfing of goalmouths is needed, localised levels adjustment as described above may also be needed beforehand. Turf should only be used if adequate time is not available to grow in new areas (i.e. 10 weeks). The turf should have similar sward content to that described in section 4. The soil the turf is grown on should be sandy, with few fines. When turfing, the objective should be to place a sandier material over the indigenous soil so the roots will be encouraged through the soil and hold the turf in place. Clubs should avoid turfing with high clay content turf as this is likely to provide future maintenance and performance problems.

Turfing has the potential to cause level irregularities so it is important to ensure the turfing areas tie in correctly with the surrounding areas. If a laser or dumpy level is not available a piece of string and two pegs should be used to ensure a “turfing mound” is not being created on goal mouth areas. Fibre reinforced turf can provide extra strength and wear characteristics to turfed areas and can be considered on a case by case basis. Most fibreturf is grown on sand rootzones and hence is prone to drying out quickly. Before turf is ordered, the club should ask for a sample of turf with soil and sward analysis to be delivered for assessment.
7.2 Treatments and Applications

Sward improvements on pitches

The majority of Irish football pitches contain a mix of perennial ryegrass with annual meadowgrass. In many cases pitch swards are predominantly annual meadowgrass, which is a shallow rooted, poor wearing high input grass in comparison to perennial ryegrass. An increase in ryegrass composition can be encouraged by yearly overseeding with better cultivars. Seed should be approved on the basis of their scores for live ground cover and visual merit as detailed in table S1 of Turf Grass Seed booklet, published yearly (www.stri.ie). A mean score that is greater than 7 will select the best performing cultivars.

If dead grass or organic material is identified at the base of the sward a scarification may be justified. The approach used to scarify is machine specific, with some lightly raking the sward and others aggressively cutting through and opening up the surface. Following scarification, overseeding takes place which is generally either drop and dimple seeder or stitch seeder. Stitch seeding tends to give better germination in existing swards. After overseeding, it is essential that the pitch is fertilised and watered to encourage germination. Where grass cover is sparse, newly overseeded pitches should be given at least 8 weeks rest period to allow adequate cover develop. During this period regular mowing should be carried out.

Soil Profile Improvements

The soil profile is a very important part of football pitches as it determines many of the performance characteristics expected from the surface. Sand topdressing is an essential part of soil profile management, especially on clay soils. Research has shown that sand topdressing improves drainage, retains surface cover and reduces hardness on pitches if carried out correctly. Sand choice has been discussed previously and the same selection criteria exist for this process. Sand topdressing should ideally be carried out during the growing season and be in combination with verti-draining. This allows sand to be brushed into channels and improve drainage and rooting depth. Also, a layer of sand on the surface will prevent soil smearing and spreading on the surface. Sand topdressing should in most cases be followed by fertiliser and irrigation application. If irrigation is not available, sanding should be carried out in dry weather but when rain is expected.

Fertiliser Applications

The purpose of any nutritional programme is to provide sufficient nutrient for the turfgrass plants to recover from wear damage. The essential elements for plant growth must be present in the proper amounts and the proper proportions for optimum growth and development. The turfgrass root system is ideally suited for nutrient uptake because an extensive fibrous system has a large surface area over which to absorb the nutrients. Nutrient uptake is therefore determined by the characteristics and condition of the root system. Shallow root systems are unable to draw upon reserves deeper within soil profiles and require more careful management whilst the promotion of deep healthy rooting is to be encouraged. Nutrient uptake is also determined by the oxygen status of the rootzone and is impaired by waterlogged soil conditions, compaction or indeed a lack of soil moisture. The most important nutrients that should be applied to turfgrass stands are nitrogen, potassium and phosphorus.
Nitrogen is the nutrient that should be applied in the largest amount in any turfgrass nutritional programme but excessive stimulation of shoot growth through nitrogen applications can result in the death of the turfgrass root system as carbohydrate reserves are utilised to support shoot growth. Excess nitrogen can also result in a decrease in cell wall thickness leading to plant growth of lower wear tolerance. The wear tolerance and recuperative capacity of the turfgrass is thus enhanced with moderate nitrogen levels which do not exhaust carbohydrate reserves in the roots. The level of nitrogen nutrition is directly correlated with the colour and density of the turf.

Phosphorus is an essential macronutrient required to aid grass establishment, rooting, maturation and reproduction. Phosphorus content is usually greatest in the upper portion of the soil profile and is relatively immobile. Phosphorus absorption is greatest at a soil pH of 6 to 7 and during periods of active grass growth.

Potassium is required in relatively large amounts, second only to nitrogen. Turf grasses will not show a visual response to potassium in terms of colour or growth but it does influence rooting, drought, heat and cold hardiness, disease resistance and wear tolerance. The potassium content of soils can vary significantly but only a small proportion is normally available for uptake. The availability of potassium is reduced in increasingly acidic soils where the pH is below 6.0. Potassium losses can occur through leaching and tend to be greatest in sandy soils.

As nitrogen is the most important nutrient and can influence wear tolerance, you should look to apply optimum amounts of this nutrient to provide sufficient wear tolerance and sward recovery. The optimum values for sand ameliorated soil pitches have been determined at 160-200 kg nitrogen/ha/year. These are guideline values and individual circumstances will vary depending upon sward maturity, clipping removal and growing environment. It would therefore be appropriate to review the turf nutritional programme with a view to decreasing the inputs whilst monitoring responses to the applications made. Attempting to extend the intervals between applications and reviewing the type of nutrient sources used can achieve this reduction.
7.3 Maintenance

Mowing
Regular mowing encourages a thicker sward and improves presentation on the pitch. Mowers should be adjusted for height of cut and sharpness regularly and it should be noted that mowers which are not sharpened or adjusted correctly will weaken the sward and provide a poor finish. Rotary mowers are generally less maintenance than cylinder mowers but the latter provides a better finish and helps maintain a thicker sward. In an ideal scenario a combination of cylinder and rotary mowing should be used.

Pitch Repair
With usage levels high on all pitches assessed and the need for all year round playability post match divot repair is a very important aspect of maintenance. If divots are repaired within 12 hours of forming, a considerable difference is noted in the speed of repair time. Ideally pre germinated seed should be on hand at all times prepared before big matches. This can be achieved by putting some seed in a bucket and spraying it with some water, then covering and putting it in a warm place for about 3 days. If a light spray of water is used on the seed each day this will help it to germinate.

Divots should be repaired in the conventional manner using a pitchfork. With larger deeper divots the divot itself should be removed, the void filled with a sand/soil mixture (80:20 mix as described earlier) with some pre germinated seed. In some cases replacing the void with the divot is acceptable but care needs to be taken as this could cause problems if the divot dries out. All divotting crews should be trained and clearly shown what is required as poorly repaired divots can also be a safety hazard. A proficient crew could be assembled from each club with a rota system to ensure that divots are repaired quickly and maximum recovery is achieved.

Ideally divots should be repaired before mowing after matches as the divots may cause the mower to scalp the grass as well as causing damage to the mower. Hence, a further reason to get the divots repaired quickly after matches. If any large divots run the risk of drying out, they can be watered to keep them moist and allow the seed to stay alive. Often it is necessary to return and firm in previously repaired divots before matches.

Fig 15: Mower adjustment
7.0 Pitch maintenance and renovations

7.4 Testing

Performance testing

Clubs may choose to carry out performance testing on the pitch in order to ensure it meets the requirements of the club. Performance testing should be carried out by an independent agency with the necessary equipment, skills and experience to carry out the assessments and comment on the results. This can be incorporated into design and build projects.

Assessments include:

- Live grass cover
- Grass species composition
- Rooting depth
- Stud traction
- Hardness
- Penetration
- Infiltration
- Grass height

Whether or not documented values associated with the above tests are relevant to various pitch constructions will depend on the pitch construction approach and hence may change.

Fig 17: Performance testing for traction
A summary maintenance programme for a football pitch.

Fig 16: Indicative annual maintenance activities
Sand grading curve for use on winter games pitches
Flow diagram for pitch development projects

1. Needs Analysis by Club; information gathering
2. Appointment of technical consultant (depending on project size)
3. Technical feasibility study
4. Submission of information to FAI for approval

- Design and build performance criteria developed
- Specifications, drawings, bills of quantities and contracts developed

- Tendering and contractor appointment (note requirements)
- Tendering and contractor appointment (note requirements)

- Performance testing of deliverables
- Sign off on all works by consultant

- Delivery of expected surface available for play; club takes back pitch
- Delivery of expected surface available for play; club takes back pitch
Choosing a competent consultant

Choosing a consultant

Pitch feasibility and design works should be carried out by an independent reputable turfgrass consultant. If considerable earthworks are required this consultant should also have a good knowledge of soil and water engineering or have an engineer as part of the team. Considering that the consultant will be responsible for recommendations provided, even at feasibility stage the following checklist should be completed before engaging a consultant;

- Evidence of at least three years experience on consulting previous schemes (note research and study should not be included in this)
- Reference list of at least 5 contactable clients in similar projects
- Minimum degree level qualification in a relevant soil or agronomic field
- Proof that the consultant is operating as a legitimate tax compliant company
- Independence from all contractors and suppliers
- Proof of Professional Indemnity (minimum €1.5 million) and Public Liability Insurance (minimum €6.5 million)
- Demonstrated knowledge of Irish Health and Safety and CDM regulations
- Demonstrated knowledge of contracts and contractual issues
- Ability (sub contracted or otherwise) to draft drawings and documents
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