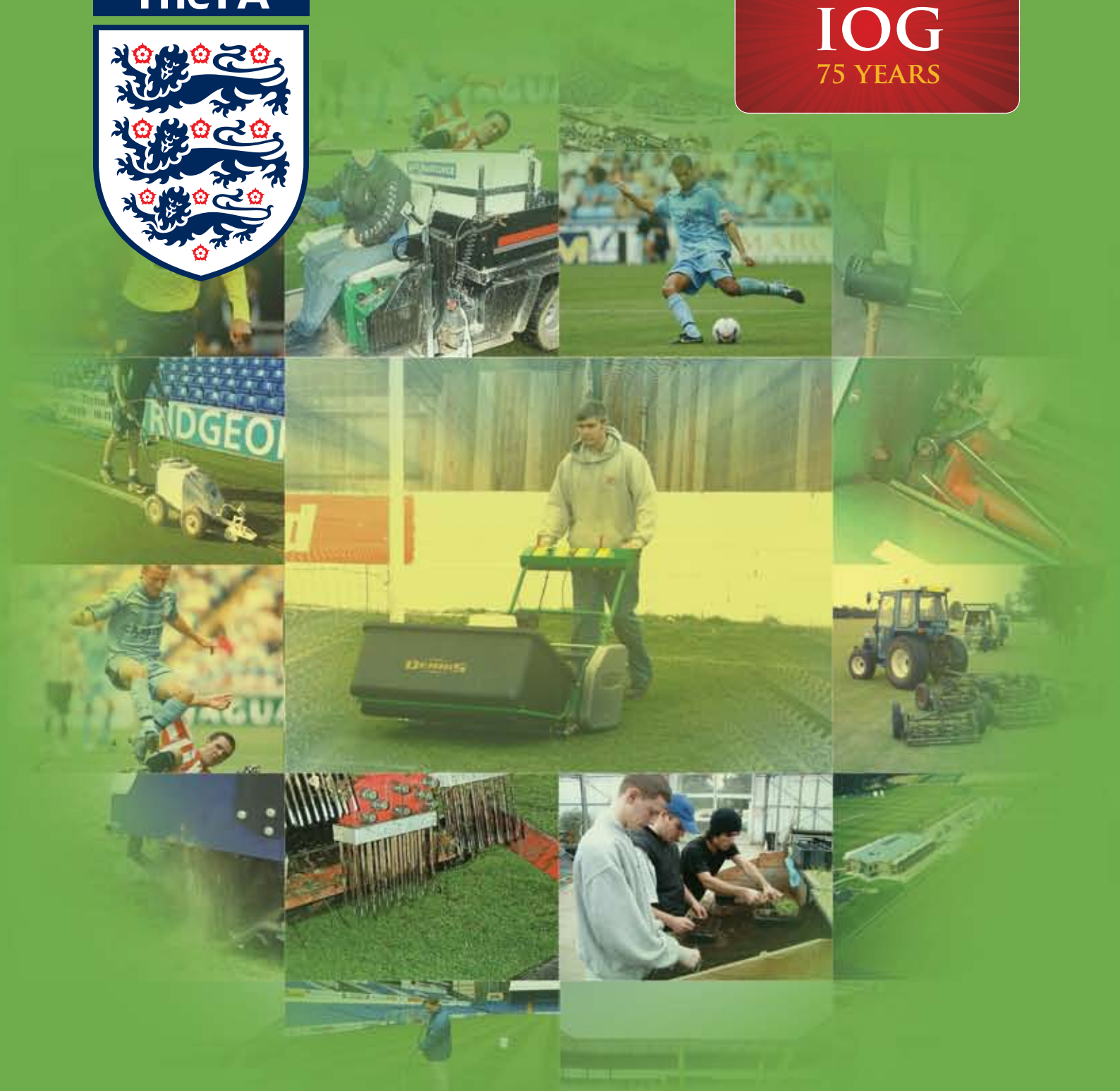
GUIDELINES FOR THE PREPARATION & MAINTENANCE OF

FOOTBALL PITCHES

The FA

IOG
75 YEARS



Contents

The Course & Objectives

About the course

- This course has been developed by **The Institute of Groundsmanship** in association with **The Football Association**
- It is envisaged that grounds staff will develop their personal skills and expertise by following this scheme of instruction
- The course is designed to provide an initial knowledge of football pitch maintenance. The course will demonstrate and apply the skills required to provide, maintain and renovate the playing surface at the end of the playing season and during the non-playing period
- The course is designed to be of equal benefit to the person working alone on a football ground or a person working as part of a larger team.

Objectives

- To provide safe working practices when completing operations on football pitches.
- To appreciate the requirements for football pitch maintenance generally
- To provide playing surfaces in line with Performance Quality Standards (PQS)
- To implement the correct sequence of operations in producing and maintaining the playing surface
- To use and compare the different materials available for the production of football pitches
- To use and compare the range of equipment available for the production and maintenance of football pitches
- To carry out repairs to the pitch after the game
- To carry out maintenance of equipment used for football pitch management.

Notes

Introduction

The role of the groundsman

The groundsman is an essential element of the sporting and recreational industry. He or she has the onerous but rewarding role of preparing and maintaining the stage on which so many sporting men and women depend for their performance and enjoyment.

It is therefore equally essential that grounds staff fully appreciate their responsibility in producing a safe and consistent surface. This will only be achieved by having the knowledge and expertise found in the science of turfculture.

Timing is essential. Even if you know what to do, this knowledge will be useless if the timing is wrong.

You must do each task:

- In the right sequence
- At the right time
- In the right weather conditions
- With a full understanding of the effect you want to achieve.

A note on Health & Safety

Many grounds staff who care for football grounds are self sufficient in maintaining and producing playing surfaces, perhaps with the guidance of a club or grounds chairman. In large organisations, you may have to report to a manager or supervisor. **On every occasion the employer and/or club is ultimately responsible for the health and safety of its workers.**

Initial Considerations

Topography

Consideration regarding the ‘lie of the land’ is most important when siting football pitches. The land should under no circumstances be severely undulating or have a steep slope across or along the line of play.

Gradients

Gradients are recommended to avoid undue fatigue to players, to assist in surface water ‘run off‘ or to compliment ‘falls’ for drainage systems, where necessary.

Recommended gradients for football pitches are 1:80 (min) down the length and 1:40 (min) across the width of the pitch, or as level as possible if circumstances dictate.

Orientation

Orientation refers to the alignment of the pitch in relation to the position of the sun. The purpose is to prevent sun glare into the eyes of key players such as goal keepers.

The ideal pitch orientation is between 285° NW to 20° NE in a north/south direction. The most common orientation is on a bearing of 345°.

Guidelines for annual maintenance

The annual maintenance of football pitches is broken into the seasons as indicated below and will be dependent on other uses of the surface.

Spring (playing season)

- Mowing should be a regular task – recommended height of cut 25 to 35mm for football but this will depend on the situation
- Light scarification of surface
- Maintain surface aeration to aid root growth, but only if surface conditions allow
- Irrigation - where the weather has continued to improve and surfaces are very dry you will need to irrigate to aid the preparation of the surface for maintenance work
- Fertilising as required after soil analysis
- Inspect for pest and disease infestation and remove as necessary.

Spring (end of playing season - renovation)

- Reduce mowing height to 15 to 20mm before scarification, depending on conditions
- Scarify the surface to remove 'debris'
- Irrigation - where the weather has continued to improve and surfaces are very dry you will need to irrigate to aid the preparation of the surface for maintenance work
- Maintain surface aeration to aid root growth. Now is the time to start deep spiking to relieve compaction (but only if surface conditions allow). If soil exchange is envisaged, the use of hollow core tines, opposed to solid tines, will also relieve compaction
- Seeding - direct drilling is always a preferred option as it ensures optimum growth conditions and reduces loss of seed
- Fertilising as required from results of soil analysis
- Verti-drain
- Top dressing.

Notes

FA Performance Quality Standards

What is it?

The Performance Quality Standard (PQS) provides a recommended minimum quality standard for the maintenance and construction of pitches. Specifically, it sets the basic standard recommended for natural grass pitches, which may be located at a variety of locations including a club site, within a park or recreational ground.

Principally, this recommends that a natural grass pitch must:

- Have adequate grass cover
- Low level of weed coverage
- Be flat
- Have the ability to drain water

If met, the PQS ensures a flat drained surface suitable for 'recreational' and competitive football activities up to Step 1 of the Non-League pyramid.

Why was it developed?

There has been no commonly recognised basic technical standard for a natural grass pitch. In order to ensure that any funding produces pitches of sufficient quality for community and non-league competitive use, it is recognised that a performance quality standard has needed to be developed for all future projects.

How was it developed?

A voluntary technical consortium was established, with representation from the Sports Turf Research Institute (STRI), National Playing Fields Association (NPFA) and the Institute of Groundsmanship (IOG).

Whose standard is it?

The PQS has been adopted by Sport England as a basic quality standard for natural grass pitches, funded under their Playing Fields and Community Green Spaces programme. Whilst it was a programme specific standard, The FA has worked with Sport England in 2004 to adopt and develop the standard for its own project programme.

Why are the tolerances set so high?

Tolerances were set as a direct result of input from the voluntary technical consortium. This body was established to agree on a common technical approach to be utilised under the programme. This included the development of the PQS.

Are you going to change it?

Sport England is currently undertaking a data checking exercise, in order to quantify the technical aspects of pitch improvement/construction. This technical data will be an important 'legacy', which will be passed onto The FA. This will allow us to benefit from the 'lessons learned' under the programme, particularly with reference to the implementation and measurement of the PQS.

Natural Grass Construction Upgrade Performance Quality Standard

ELEMENT	LIMITS	METHOD OF TEST
Sward Height mm	20-60 PS 20-75 SM	BS 7370 : P3 A3
Hardness in g	5-200	STRI method of test using a 0.5kg Clegg Impact Hammer from a drop height of 0.55 m
Water infiltration rate mm/hr	5	BS 7370 : P3 A8
Evenness – 2 meter straight edge	< 20mm	BS 7370 : P3 A4
Slope – Direction of Play Across Play	< 1.25% <2.5%	BS 7370 : P3 A5
Ground Cover %	>70 for SH 25-30 > 80 for SH 30-35	BS 7370 : P3 A6

Notes

Goal Safety

- Of goals tested in a recent survey 41% of mini soccer goals, 50% of 5 a side goals and 22% of junior goals failed stability tests
- Staff at every second site visited were unaware of the safety campaign run by the FA
- Ground conditions can affect the stability of the goals
- Ensure proper fixings are in use for the appropriate weather conditions.

Goal Inspection Sheet

Site	Walmer Road	***Pitch No.***	3
Goal Reference	Pitch 3 North End	***Type of Goal***	Socketed Aluminium
Size of goal	7.32m x 2.44m	***Stability Test Pass***	Yes / No
Strength Test	notes:	***Start Height***	mm
		Finish Height	mm
		Deflection Test	mm
		(more than 10mm is a fail)	Pass / Fail
Supplier of Manufacturer	Harrod UK Ltd	***Date of manufacture***	Feb 2005
Inspected By	Harry Pitts	***Date of inspection***	10th Jan 2006
Findings	Goal Net has holes and brokern meshes, some net hooks also missing		
Action Taken	Purchased new net and clips and fitted to goal		

Warning signs should be attached to all goal post systems

A British Standard sign should be attached

Self balanced goals offer more safety

It is important to leave some slack in the net. All supports should be out with the width of the net.

If Dug outs are required or installed they should be fixed, with the transport wheels locked if fitted. The technical area should be clearly defined.

Notes

Line Marking – Safe Working Practice

The purpose of this guide is to highlight safe working practices for the use of line marking equipment and it must not be treated as a substitute for training.

Protective clothing and equipment

- Operators must wear appropriate protective equipment
  - i. In circumstances where crushing injuries to feet could occur, toe protected footwear MUST be worn
  - ii. Depending on the formulation and work practice: apron, face shield, gloves and facemask may be required
  - iii. If pesticides are being applied then protective clothing requirements will follow the recommendations of the label and the Control of Pesticide Regulations 1986
- Avoid wearing loose fitting clothing
- Never allow children or untrained operators to operate the equipment.

Before Use

- Ensure there are no defects that could affect the safe operation of the applicator
- Ensure applicator is clean and ready for use
- Learn controls and know how to start and stop the applicator in any emergency
- Lubricate any grease / oil points
- Ensure all shields/ guards are undamaged and secured in place
- Ensure the work area is free from obstructions
- Ensure compound is properly mixed to prevent blockages
- Do not fill or re-fill the applicator on the playing surface.

During Use

- Never touch any mixed solution without wearing the appropriate protective clothing
- Walk at a speed consistent with existing conditions
- Avoid contamination of tapes and pegs
- Ensure the line marker is disengaged before leaving the line.

After Use

- Clean machine thoroughly
- Examine the machine for loose or damaged components and replace
- Complete the LOG BOOK and report defects.

One of the many jobs carried out by the groundsman that often provokes criticism or praise quickly when viewed is line marking. Done well this job can set pitches off especially when being featured on TV or when the pitch is being used for a high profile game. The secret of marking good lines is to keep equipment clean and use approved marking compounds.

Lines should be kept straight. This can be achieved by running a string along the length of the line. The string then acts as a guide allowing the groundsman to keep the line ruler straight.

Care should be taken to walk at a sensible pace allowing the machine to deliver the right amount of paint to make a good line. It also allows the operator to follow the string line.

Effective marking can be of great assistance in the training environment as well. Areas such as grids or specialised areas for goalkeepers need to be as well defined as the match pitch. Circles such as the one shown in the picture are often used in a training ground environment for special drills. As with other marks they need to be clear and well defined. The end of the string should be fixed in to the ground by a peg. The radius should then be measured. Once established the string should be pulled tight and another peg tied onto it. This peg should be used to scroll a line in the grass. Once the circle has been etched in it can be painted.

For areas that have more than one pitch the machine featured to the left is ideal. It is designed for marking multiple pitches in a short space of time. It can be fitted to any utility vehicle making it very versatile. The large tank enables the operator to carry enough compound to mark several pitches at a time with out having to stop and refill.

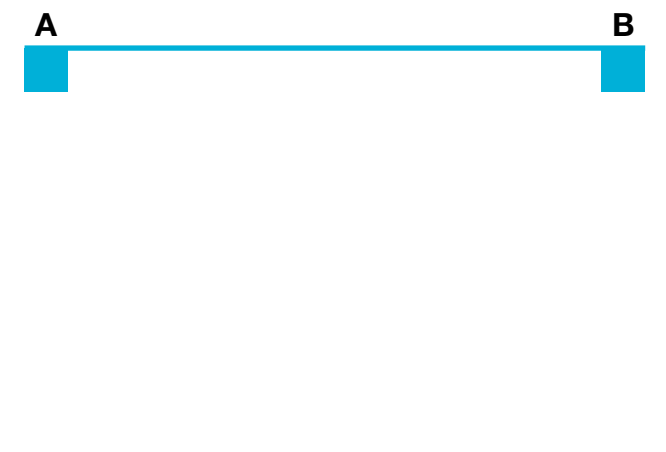
Above & below: Fleet Fastliner machine

A circle being etched in and then marked properly.

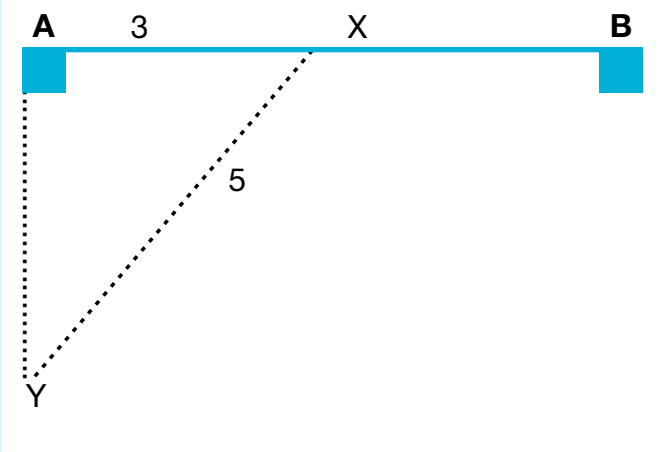
Above: a Kombi line marker

Finding a right angle

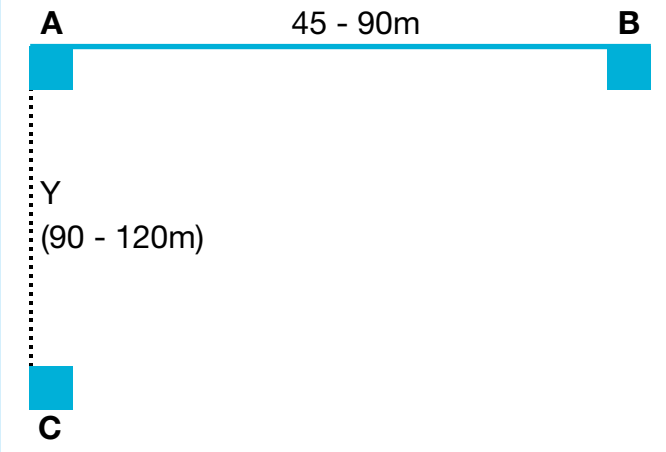
One of the most tried and tested methods of finding a right angle is by using the 3,4,5 method. This method is essential when marking out a pitch for the first time. The five step guide set out below guides you through step by step ensuring you will end up with a pitch that is square.



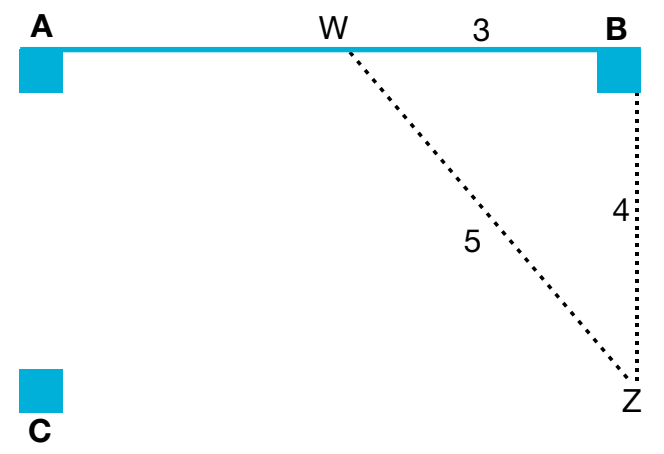
1. Place a taut line to produce the base line and mark the corner positions A and B



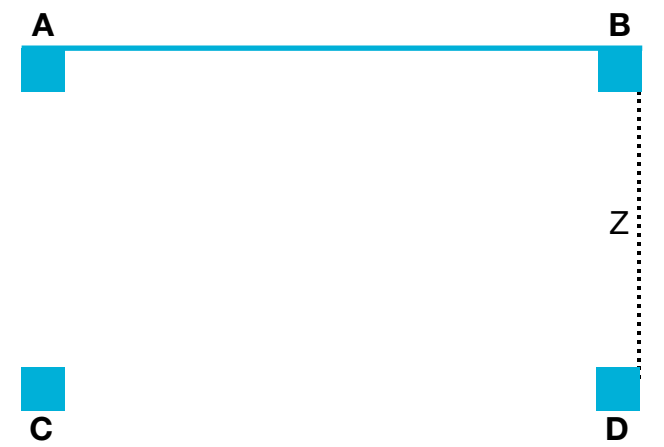
2. From the corner peg A extend a tape for 30m point X. Extend a tape 40m from A to Y. The distance from Y to X must be 50m, which will give a right angle at A.



3. Extend the line A - Y for a length of 90 - 120m to identify the 3rd corner peg of the pitch at point C



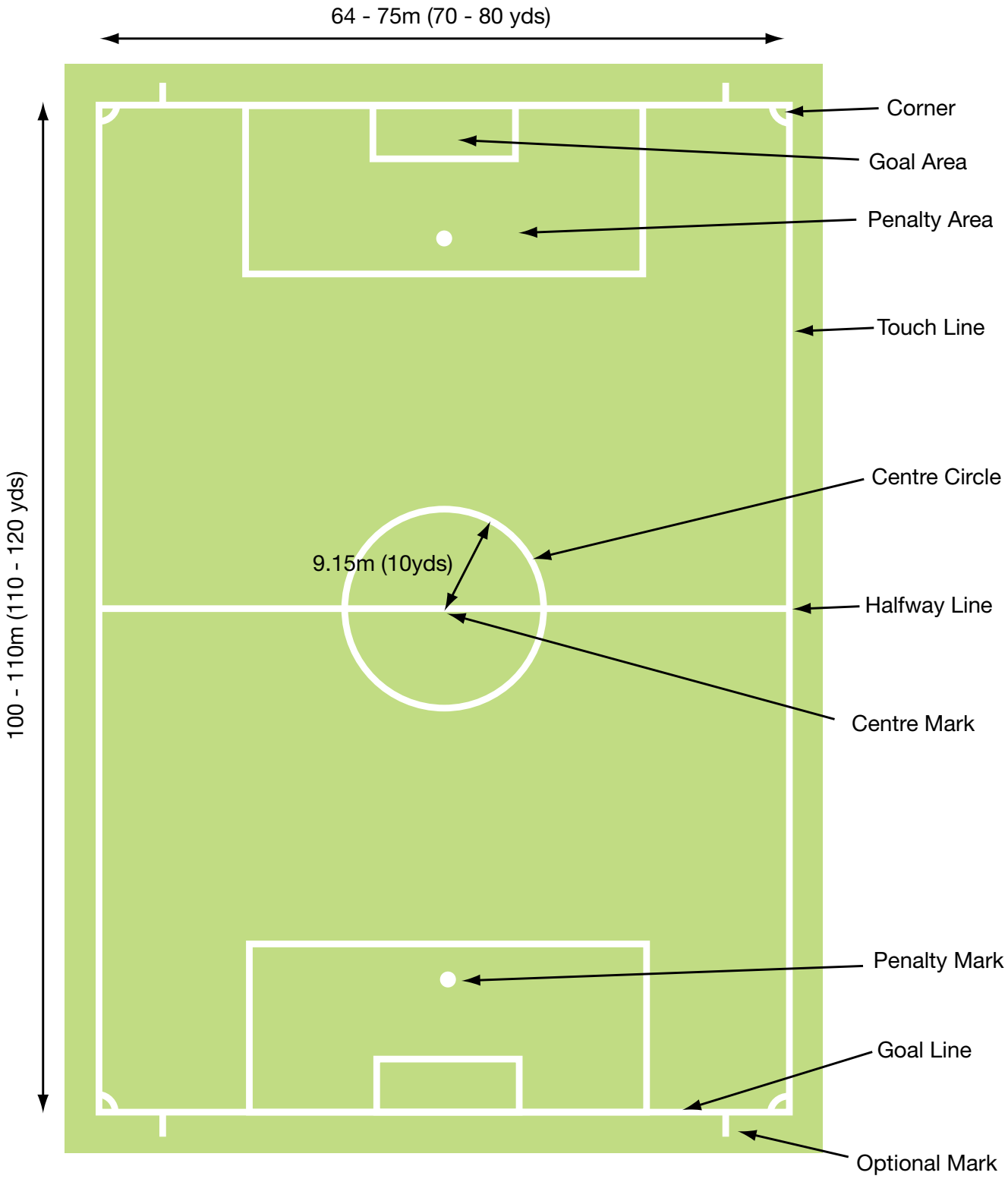
4. From the corner peg B extend a tape for 30m point W. Extend a tape 40m from B-Z. The distance from Z-W must be 50m which will give you a right angle at B.



5. Extend the line B - Z to the required length to produce the 4th corner peg at point D. A complete rectangle is now made for the pitch. The accuracy can be checked by measuring the diagonals A - D and B - C

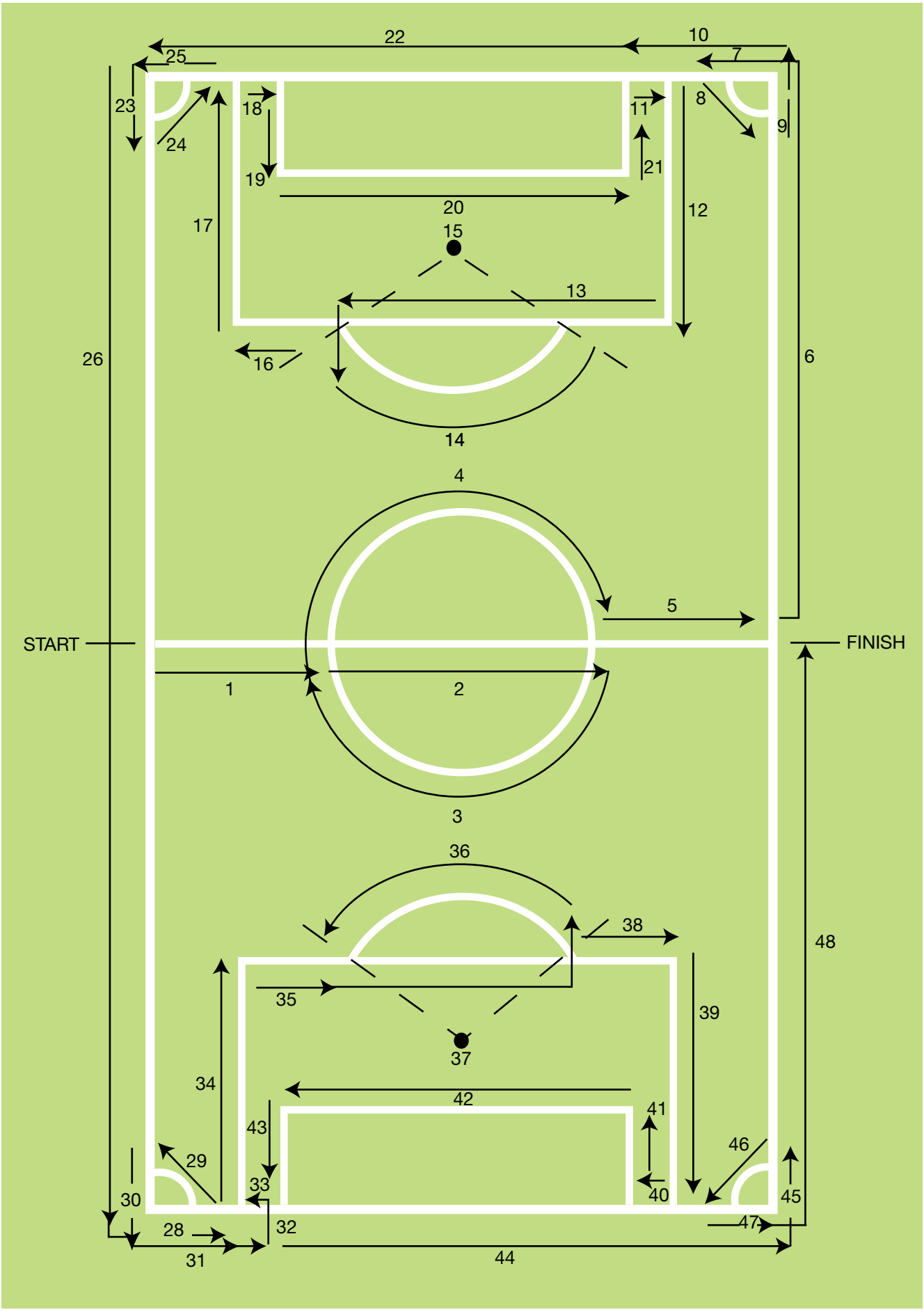
Marking sequence for association football

Below: an association football pitch.



Follow the steps indicated below to relate to the sequence for marking a football pitch

The diagram below shows a suggested route to follow when marking the pitch. Just follow the numbers.



Notes

MOWING

Mowing is one of the most important football pitch maintenance operations. Mowing can dictate the appearance, health and vigour of the grass sward. Mowing is basically the pruning of the grass and as with pruning a shrub or tree, grass needs different degrees of mowing dependant on seasonal factors.

Mowing influences grass density, sward characteristics and weed invasion. The height of cut and frequency of cut will affect the balance of the grass specie. The playing surface will be greatly affected by the removal or return of grass clippings.

Mowing of football pitches is achieved in two principle ways;

1. Pedestrian controlled mowing machinery
2. Ride -on tractor mounted or trailed gang mowers.

The use of pedestrian mowers usually allows for the collection of grass clippings via the grass boxes while tractor mounted or trailed machinery return grass clippings to the pitch surface. There are four types of cutting action on mowing machines-cylinder, rotary, flail and reciprocating. Football pitches require the use of cylinder mowers for a better quality finish as cylinder mowers cut rather than tear the grass. While rotary mowers are sometimes used neither they, nor a reciprocating mower, will give the desired finish.

Cutting heights

Typical heights of cut;

The pitch: playing season ideally 25 – 30mm

Training ground ideally 25mm to 30mm to ensure protection of the surface

The above heights are recommended heights of cut. Pitches cut higher than this will result in dramatically slowing down the roll of the ball and make its movement erratic across the surface so reducing the quality of the game. It will also make running more difficult and be tiring for the players as well as increasing the risk of injury.

Before using a mower

- Check fuel, oil levels and air cleaner
- Learn controls and know how to start and stop the machine in an emergency. If in doubt consult the operations manual
- Lubricate all chains and grease / oil points
- Ensure all shields / guards are undamaged and secure in place
- Check the condition and security of the blades, blade bolts and cutter assembly. If damaged replace in sets to maintain the balance
- Check cutting height
- Ensure the blades and drive clutches are disengaged.

During use

- Ensure the work area is free from obstructions before beginning to mow
- Disengage cutters before crossing paths or stop the engine of rotary mowers
- Never make adjustments / repairs with the engine running other than carburettor adjustments. Always switch off engine and remove the spark plug lead
- Never touch any moving parts
- Disconnect the spark plug lead if leaving the machine unattended
- Do not walk backwards when operating rotary mowers
- Prior to refuelling, stop engine and allow cooling
- Do not fill fuel tank on the grass surface.

After use

- Clean machine thoroughly
- Examine the machine for loose or damaged components and replace
- Complete the **LOG BOOK** and report defects.

Cylinder mowers

Cylinder mowers have a cutting action which is similar to a pair of scissors. It therefore provides a clean cut without tearing the grass. There are two working parts to the cutters - the cylinder and bottom blade.

The blades of the cylinder are made with a spiral twist to ensure a clean cut and lessen damage from any objects hit by the machine. The blades are connected by rivets or welding on a series of flanges to the centre shaft. A rapidly revolving cylinder with 5 -7 blades or more provides the best cut. Chains, belts or gears may drive the cylinder.

Left: Parts of a cylinder mower

The bottom blade should be strong but not too thick to prevent a low height of cut. The bottom blade is attached to the sole plate. Careful adjustment is required to ensure that the cutting blades wipe the bottom blade without being too tight to encourage wear on the cutting surfaces.

The remaining parts of the cylinder mower include the front and rear roller, the throw plate and the grass box. The rear roller may be cast in one section or divided into two or three to assist with turning.

Adjustments to a cylinder mower

There are several adjustments necessary to a cylinder mower to ensure the best use of the machine. Before carrying out any adjustments all operators should have read the operator's manual for the particular machine. At all times safety should be considered before any adjustment to a mower. It is necessary to take the following steps:

1. Switch off the engine
2. Switch off the fuel
3. Remove spark plug lead
4. Support the mower securely
5. Do not adjust the mower on the surface (to prevent fuel and oil spillage damaging the turf).

Setting a pedestrian mower

Probably the most common job any groundsman will do will be to cut the grass. Quality mowing will be as a result of a good operator taking time and care to prepare the mower in a professional manner. The first step will be to establish the cutting height of the mower. Cutting heights will vary depending on which area is to be cut and the time of year that the cutting is being carried out.

The height on football pitches can vary between 17mm ($^{3}/_{4}$ of an inch) to 32mm ($1^{1}/_{4}$). This is quite a variance but should cover all mowing throughout the year. I have a preference to cut at around 24mm in season lifting the height to 30mm in the close season when trying to establish the new swards.

Part of a groundsman's tool kit should be a setting gauge. These gauges can be either bar gauges or a frame. Whatever type of gauge is selected the setting principal is the same. The setting bolts will be measured and set to the chosen height. The gauge will be placed under the mower with one end touching the front roller and one end touching the rear roller. It is important that the gauge touches both rollers. At this point the lock nuts holding the height adjustors on the mower should be slackened. The front roller should then be moved up or down until the head of the bolt on the gauge can locate on to the bottom blade. When this is done the front roller should be touching the gauge. The front roller should be able to be turned by hand but should not spin freely.

If you are using a bar gauge you should check the height at both ends and the middle. If you are using a frame gauge then check that the roller touches at both sides of the gauge. If you are sure the chosen height has been set, lock the adjustments up before removing the gauge.

The height of cut

The height of the sward found on a pitch will have a profound effect on how that pitch will perform. Adjustment of the mower is critical to success. Raising the front roller will lower the height of cut and lowering the roller will increase the height. The usual method for testing the correct height is to place a straight edge beneath the machine and from the rear to the front roller. The gap between the straight edge and the top of the bottom blade is the height that the machine will cut the sward. Allowances must be made when the surface to be cut is damp as the weight of clippings in the machine being used will have a marked effect on the height, which will have been already set.

Many grounds staff will now use a tool specially made for adjusting the height of cut. This can be made of a straight bar or frame as shown in the picture. A bolt is threaded through the bar, which can be adjusted to the height of cut required. It is then placed onto the two rollers and the correct adjustments made.

Height of cut - distance from top of straight edge to top of bottom blade.

Adjusting the on cut

Having set the height the next step is to ensure that the cutting cylinder will give a good clean cut. Most cutting machines will have setting screws at both ends of the cylinder. Using the correct sized spanner, these screws should be turned slowly trying to do the same at both ends to ensure an even cut across the cylinder. Care should be taken not to over tighten the cylinder. Should this happen the reel will screech when switched on and tramlines (black lines) may appear on the cut. An ideal situation is when the cylinder and bottom blade are just touching.

To be certain that the machine is cutting evenly and cleanly all over the cylinder should be checked using a thin piece of dry paper. The paper should be held between the cylinder and the bottom blade. Using your free hand, carefully turn the cylinder round onto the bottom blade and test the cut. This should be done along the full length of the cylinder. Having checked the height of cut and the quality of the cut the rest of the machine should now be checked. These checks should take in the fuel, oil and guards.
The machine should also be greased if required.

Using a pedestrian mower

Having set the mower for use care should be taken when using the mower on the pitch. Most mowers have the grass box out over the front of the machine. This can add quite a bit of weight to the machine. If it is allowed to accumulate especially when the grass is wet it can affect the height of cut. Extra care should also be taken when turning. Damage can be done to the areas along the goal line and touchline when turning. The use of boards to help spread the weight of the machine during turning can help prevent this.

Above: A jacobsen Lf 3800 5 gang Unit with grass catchers

Above: A 5 gang trailed unit

Left: A Ransomes T-Plex 185 triple

Ride on mowers

Ride on mowers, and gang mowers, are used on larger areas of sports grounds due to their speed and quality of finish. For an acceptable and more professional finish the mower must have cylinder cutters.

Hydraulically driven ride on and gang mowers tend to provide a more uniform cut than gear driven or trailed sets, and also produce a better cut in wet conditions. Uniform machine setting is essential and careful measurement of height of cut is required. The cutting unit must be set on a level surface as described in the height of cut sections above. Most gangs mower units have notches on the side frame which adjust the rear roller and thereby the cutting height. Gang mowers with floating heads may require different settings compared to conventional single unit machines or those with fixed cutting heads. If there is any doubt then consult the manufacturer's handbook.

To avoid risk of tyre depression marks the direction of mowing should be varied where possible for each cut, when using tractor drawn machines. The tyre pressures should also be checked. Differing pressures can cause the height of cut to be out on the cutting units.

Setting and using ride on and trailed gang mowers

Many groundsmen manage large areas of sports turf, often covering more than one sport. In order to maintain an effective mowing programme it is essential to mow with larger ride on or trailed equipment. The modern day ride on machines have taken the place of the old trailed gang mowers although open gang mowing is still widely practised. Ride on mowers can carry units in configurations of 3.5 or 7 units. This is the same as the old configuration of the trailed gang mowers.

A number of companies manufacture mowers and models will range from 3 to 7 gang machines. The machines are designed to cover large areas of ground in as short a time as possible but giving a quality cut. Machines shown above will have ground speeds of around 15 m.p.h. with a cutting speed of around 6 m.p.h. This will allow a full size pitch to be cut and boxed of in around 40 minutes or less. Despite the size of machine each one is designed to spread its own weight to minimise surface compaction and damage to the leaf. This is usually done through the use of special grass tyres.

Not all areas are suitable for the larger machines to work in. One of the machines shown is a 3 gang T-plex 185 from Ransomes. It is ideal for tighter areas with its 3-wheel configuration. Like all ride on mowers the machine operator has good all around vision from the seat position. Most of the machines now have diesel-powered engines with some of the latest models being electrically powered using special batteries.

Quality of cut

Quality of cut is affected by the setting of the mower blades. Implications of incorrect mower adjustments are:

a. ribbing

b. tram lining

c. tearing.

All of the above will detract from the look of the pitch and are easily avoided by attention to detail when setting the mower up.

Sward measurement

A useful tool from the American golf industry is the lawn measure. It is a tool used to monitor the height of cut on the mowers. It is particularly useful when using ride on mowers and maybe one unit is slightly out. The tool is basically a prism in a frame. The side of the frame is marked in mm. When placed on the grass the length is mirrored through the prism allowing a reading to be taken.

Left: Lawn measure.

General mower maintenance and summary

If the guidelines set out above are followed then the mowing operation will give a good quality cut and help to maintain a healthy sward. Remember, all moving parts should be oiled or greased as stated in the manufacturer's handbook. Ensure that excess oil is not applied as this may drop to the grass and cause damage. If a machine is regularly used it may require a periodic regrind to the cylinder to maintain the cut quality. All grass clippings should be removed after use either by a stiff brush or airline, or high-pressure water jet. After washing a protective lubricant such as duck oil should be applied to prevent rusting.

Notes

Aeration

Definition: Operations which are carried out to improve turf by physical methods to ventilate the soil, improve drainage and encourage better root development. A process by which air in the soil is replaced by air from the atmosphere.

Why aerate?

The purpose behind all aerating techniques is to maintain or increase the proportion of pore space within the soil structure. Under the influence of play and maintenance practices, pore spaces become constricted as compaction increases.

Compaction of the root zone layer leads to ponding or more extensive water logging, thatch build up and a reduction in playing days.

The surface also suffers unnecessary damage during play or training. Once such a situation is noted, deterioration in sward quality shows in rapid annual meadow grass ingress.

In addition to maintaining free drainage, aeration has other positive benefits. An open, dry soil structure will warm more quickly in the spring promoting root extension, and will enhance the percolation of irrigation water during drought summers.

Aeration equipment

There are a great variety of implements available, though much is repetition of familiar techniques. There is aeration equipment for all shapes and sizes of turf area. The large expanses of winter pitches lend themselves to tractor-mounted aerators of up to 2 metres in width. Hand forks have an important role on local areas and worn goalmouths. Aeration is such an important and frequent operation that every sporting venue should have its own equipment. The choice on which to buy or hire must be determined by the size of the area to be covered and the frequency of aeration work undertaken.

There are three basic types of aeration technique most commonly employed on sports turf:

1) Slit tine aeration

2) Solid tine aeration

3) Hollow tine aeration.

Slit tine

Slit tining is the most frequent aeration treatment carried out on sports turf in this country as it introduces air into the soil profile whilst causing minimal surface disturbance, primarily in the summer months. Slit tines are described under a variety of terms; knife tines, diamond tine, chisel tines, and root prunes. The nomenclature relates to the shape of the tine or its action.

Chisels or root pruners may be safe to use during the summer, provided efficient automatic irrigation is available. Failure to irrigate during summer slitting can result in surface cracking. However do not over water merely to facilitate the use of slits rather than safer alternative forms of tine.

Slit tines are available on the complete range of aeration implements. The working depth varies from 75mm to 150mm on pedestrian units, down as far as 300mm on the larger football pitch aerators. Many tractor mounted units have pressure frames or are controlled by downward pressure from the tractor to give variable depth of penetration and to facilitate full depth when needed.

The maxim that you should always slit as deeply as possible is inaccurate. Always aerating at the same depth will create panning at that depth, obviously less of a problem at 300mm than 75mm but a problem nonetheless. Frequency of slitting must relate to the quality of soil to be worked and the needs of each specific site. Anything from weekly to monthly treatments could be appropriate.

Working along the same direction in anyone slitting season as cutting across previous slit marks could promote serious disturbance to the playing surface, if not immediately then certainly through dry summers. Slitting can be overdone and result in unevenness; a situation exacerbated during frosty spells, or on heavy saturated soils when taking any machinery over the ground will cause more damage than the operation will do well.

Staring a slitting programme for the first time can be disruptive though after a few passes lifting should be kept to a minimum. The initial damage is usually due to very poor rooting, a direct consequence of no, or very limited, aeration work in the past. Units drawn behind compact tractors for relatively small areas of fine turf like, golf greens, often have a pressure roller following the slitter to smooth down any slight lifting. Slitters without such a roller can leave tufts of grass on removal of the slit from the ground which, unless smoothed down, can be cut off when next mowing so producing small gaps in the turf cover.

Solid tine

With the danger of slit marks opening through dry periods in the spring and summer, but with the continued need to limit compaction through the main playing season, solid tining provides a safe alternative to slitting.

Solid tines produce a round hole which will not gape. The primary purpose for solid tining through the drier months is to contain the degree of compaction building up and also to retain a permeable turf surface receptive to watering. Local treatment is generally the rule for solid tining although tractor mounted mechanical treatments are employed to treat the entire surface area. Hand forking of goalmouths and centre circles on football pitches can help retain ground cover in these well-worn areas through the playing season.

As the objectives for solid tining mainly relates to the top 100mm of the soil profile, most solid tining tools can work through this depth. The desired hole spacing would be around 50mm centres. The frequency of the operation will depend on the intensity of use of the pitch. It should be remembered that the entire root zone region can be solid tined and this must be done as part of an over all aeration programme. A variety of different sized tines and equipment can be used for this purpose. Much of the equipment now used such as the Verti drain or Wiedenmann has a unique heaving action which in ideal conditions will fracture the soil or root zone creating many small fissures in which air and water can move and in which root can develop.

The possibility that solid tining might increase compaction has been proposed with the soil being squeezed in between the tines. This may have some factual basis but the need to solid tine for the reasons already outlined, outweighs any minor firming of the top soil which can be over come by other aeration techniques. Drum and punch action solid tine machines are used, but penetration is cleaner and deeper with those implements utilising a hydraulic ram systems or other power source. There is the danger of weak rooted turf rolling up like a carpet with the drum units.

Hollow tine

Physical removal of a core of soil from the profile is the purpose behind the use of hollow tines. Primarily for the removal of thatch, poor quality soil or to reduce severe surface compaction, hollowing tining introduces a great volume of air into the surface layers of the soil profile. Hollow tining at 50mm centres can remove up to 5% thatch.

Top dressing is usually applied after hollow tining but leaving the tine holes open is not unknown, particularly for late autumn treatments when top dressing could cause smothering. As for solid tines, hollow tine units mainly work to a depth of 75-100mm although some of the more modern equipment can work down as deep as 250mm making them ideal for soil exchange work. The diameter of the hole produced can vary from 6mm to 25mm, and the size of tine used has a direct bearing on the spacing between the holes. The very narrow tines can work as close as 25mm centres whereas the larger tine spacing would be widened to 50mm for 12mm diameter tines and up to 100mm for the largest tines.

The narrowest of tines can be used occasionally right through the year as they cause minimal disturbance to the smoothness of the playing surface and are very useful to improve the penetration of irrigation water in areas of dry patch or prior to over seeding. Larger tines should be limited to autumn or spring use.

Hollow tining also has a role to play on the improvement of levels. Judicious top dressing and light rolling can aid settlement. Over doing hollow tining can produce a soft playing surface. Not only are you removing up to 5% of thatch with each treatment but an equivalent volume of top soil, replacing the soil with top dressing but without firming. Heavy top dressing after hollow tining can lead to layering in the profile unless consistent materials are used year in, year out. If there is a significant problem in the top layers of the profile hollow tining may be necessary once or twice a year for a number of years. With no specific problems to overcome, less frequent coring is adequate.

After dry summers dry turf surfaces have been thoroughly opened up with hollow tining in the autumn to re-wet powder dry soils. Hollow tining has been seen as the most effective means of achieving this aim whilst causing minimal disruption.

In the past hollow tining has been considered one of the slowest and most laborious of aeration techniques. The introduction of faster pedestrian units, compact tractor mounted hollow tining units have reduced the feeling of intimidation when faced with the need to hollow tine. Tractor mounted spoon tine units have been with us for some time and are useful for treating large areas. Such units can cause some severe disturbance though springs and turf fingers are available for some models to minimise such damage.

Above: A verti drain fitted with 12mm solid tines

Some drum type hollow tiners are able to collect the cores within the drum itself. Other hollow tiners leave a trail of cores on the turf surface which has to be collected separately though can be windrowed to speed up the process. Many of the pedestrian, self propelled and compact tractor implements have interchangeable tines, capable of taking slit, solid and hollow tines.

Sub soil aeration:

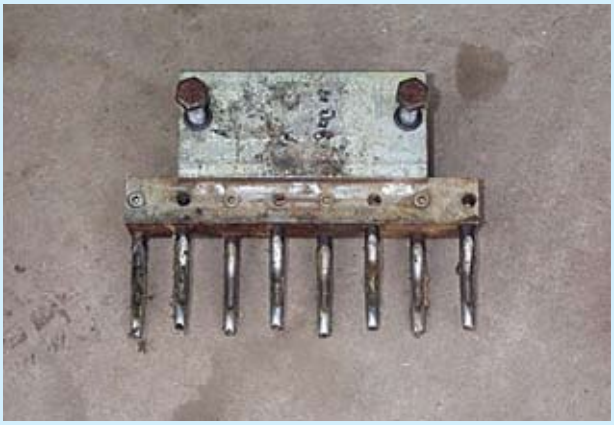
Like other operations aeration has moved on at a pace with several new machines available on the market. Machines such as the Earthquake and Rodgers Root Zone Injector are two examples of this. The Earthquake and the Blec Groundbreaker are solid tine aerators but unlike the piston action of the verti drain or Wiedenmann they aerate on a rotating drum using long slicing tines to break the ground. As the tines cut through the ground they cause forward and sideways vibration completely de-compacting the ground as they pass through.

The Rodgers Root Zone Injector and the Toro Hydroject aerate by blasting in water at high pressure. This new technique originated in the U.S. but machines have been developed in the U.K. in recent years. The Toro hydroject also does a similar job. Other types of aerator work by injecting high pressure air or by drilling into the root zone.

A Blec aerator cuts and slices through compact soil

A side view showing the Blecs slicing tines

Hole pattern from hollow coring



Multi tine head

Hollow cores being punched out ready to mix with new material

Cores and sand start to mix

Close centred pencil tines are good for creating access for new root to develop in to

Summary

Aeration is one of the most vital maintenance operations to be carried out on any sports turf area. Its primary function is to speed up surface water removal by improving the drainage characteristics of the soil. Beyond this obvious scope aeration can be invaluable in improving the efficiency of irrigation and improving levels. There is a tremendous variety of machinery to choose from to complete essentially the same task. Expertise is necessary to appreciate the type of implement to be used for a particular situation as part of a regular programme and for one – off trouble spots.

Notes

Scarification and Verti-Cutting

Introduction

Decaying organic matter can build up on the immediate surface of the turf, especially when the clippings are returned to the surface. This produces a thick impermeable layer that reduces the air, water and nutrient intake into the soil, subsequently producing a weak sward which may be prone to the following;

- germination of moss spores
- introduction to fungal diseases
- introduction of weed seeds, particularly in the summer
- spread of unwanted grass seed

Prevention of thatch

The maintenance of the winter sports ground should encourage the maximum amount of activity of bacteria and other micro-organisms. This will help provide a quick decomposition of thatch.

Poor aeration and compaction of soil will result in bad drainage and reduction in bacterial activity.

Avoid high nitrogen applications that give lush growth leading to an accumulation of organic matter and thatch.

This decaying matter is called thatch. Some benefit may be gained by a layer of thatch from the impact absorbency quality provided but the advantage gained is far out-weighed by the disadvantages outlined above. It is therefore better to rely on the impact absorbency provided by grass cover and soil moisture content.

Thatch removal is achieved in varying degrees depending on the type of equipment used and the severity of the operation.

Thatch removal from areas the size of football pitches is usually achieved, if and when required, by mechanical means. Implements are either trailed or mounted on the three point linkage of tractors or similar prime movers.

Necessity may require these operations to be carried out during some of the drier periods during the year. However, it is then essential to only scarify the plant and not the soil surface as any marks left can open up as the pitch dries out.

Several double passes would be required by the equipment to be carried out alternately with continuous mowing. All debris MUST be removed after scarification. There are several proprietary pieces of equipment on the market for this purpose.

It is important to set any mechanical equipment up correctly in order that severe damage to the soil surface does not occur.

Verti-cutting

Verti-cutting is very similar to scarification, in that it assists in thinning out the sward and removes dead material, but it does not cut into the surface.

On sand based pitches verti-cutting is now replacing harrowing, but this is in the minority and local authorities will still harrow.

Verti-cutting will remove surface thatch and thin out vegetation. It cuts vertically through living material which is not affected by normal horizontal mowing and should be carried out routinely.

Verti-cutting should be carried out in at least two directions. The process will assist in increasing shoot density and the tight vertical growth required for a good playing surface. This system will greatly increase the grooming of the surface.

Notes

Brushing, Dragmatting and Harrowing

Benefits derived are:

- Improved quality of grass
- the dispersal of dew from the surface
- the scattering of worm casts
- sits the grass up prior to mowing
- striping for presentation

Most of the operations carried out on football pitches are done with tractor mounted or trailed implements. This causes some surface compaction from tractor wheels and implements (particularly at turning points) and must be relieved by frequent surface spiking.

Brushing and drag matting can be carried out by hand, especially where light work is required, for instance the removal of dew can be carried out by dragging a rope across the ground – a form of switching.

Any work that involves the groundsman walking the ground will obviously increase the opportunity to inspect the pitch for any problems.

Brushing removes surface material, which is subsequently picked up in the grass box. Scarifying is suitable for the removal of near surface thatch layers without penetrating the underlying soil.

Harrowing can be a useful maintenance operation. The harrow used should be a smooth or short toothed chain grassland type, which will have the advantage of evening out the surface and levelling footmarks when the pitch surface is churned up after matches.

Although harrowing is a very useful maintenance operation it does have the effect of ‘smearing’ moist, bare surfaces which restricts the downward movement of water causing surface puddling.

It is essential therefore to follow all brushing, dragmatting and harrowing operations in these conditions by spiking to re-open the pitch surface.

Brushing, harrowing and dragmatting can also be used to work in top dressings i.e. sand, into the surface.

Left: SISIS Zig Zag brush

Notes

Spraying

Mistakes can happen

Notes

Irrigation

Definition: The controlled application of water to the turf surface.

Introduction

An important part of any pitch maintenance programme is the watering. Water should be viewed as a tool of the job. It has its place and like any tool can cause damage if misused.

The rate of water required to sustain a pitch will vary on the type of construction. Sand type constructions will require more than soil-based pitches.

It should be remembered that any new sward would need water to develop. Once developed it needs water to survive. Water is also used to enhance the speed of the ball over the surface and managers at all levels of the game prefer to play on a wet top.

Maintenance of data / records

It is useful to keep the following records when irrigating:

- Rainfall
- Amount of water used (especially if water is metered)
- Regular weather records.

Timing

It can be fairly stated and understood that irrigation in the winter months is usually not required. However, it may be required in the spring through to August / September. Additionally irrigation during the summer months will be required to;

- Aid maintenance operations such as aeration
- Aid grass recovery after play
- Maintain healthy, vigorous grass growth
- Facilitate a level of impact absorbency
- Aid fertiliser applications
- Germinate seed
- Prevent stress
- Effect speed of ball across the pitch

Incorrect irrigation will encourage poor root structure and therefore poor stability.

Irrigation systems

The systems that are used to apply the water come in various forms:

- Automatic
- Semi automatic
- Static sprinkler.

Automatic

This would be considered the Rolls Royce of systems. Water is applied to the pitch by sprinklers that are in the ground. They are connected to a ring main that carries water from a holding tank. The water is pushed round by a pump. Each head is operated in turn from the controller. The controller is usually housed by the pump in a shed. The centre of the pitch is usually watered by three heads that are fed by hose from a valve box. This is to make life easier should there be a problem. Such systems are costly to install but are the most efficient way to apply water. It is important that users of automatic systems have them checked periodically to ensure that the flow and distribution of the water are correct. Pump pressure should also be checked to maintain uniformity.

Above: Flow and distribution test

Above: A control panel for an automatic system

Semi automatic

This system usually features travelling sprinklers with a hose to a mains supply connecting them. The pressure of the water passing through the sprinkler drives a gear, which in turn drives the sprinkler. The sprinkler passes over the pitch slowly spraying the water over a wide area. The draw back with this system is that it generally has to be done by day. This results in water being lost to evaporation. It can also be time consuming if more than one sprinkler is involved.

Left: Travelling sprinklers working. While you can cover a big area, the sprinklers have to be watched and coverage is not uniform.

Notes

Fertiliser Application

Introduction

All application of nutrients in the form of fertilisers must be based on good information and sound management planning, and this can only be achieved from the information gained from a good soil analysis.

Fertiliser may be applied to maintain the health of the grass and appearance of the football pitch. It is also used to help pitches recover after long periods of play. As with all turf surfaces different nutrient levels are applied at different times of the year.

The basic method of feeding turf is to apply small quantities of specially formulated fertilisers at various times of the year. Before doing this it is very important that you understand the reasons for using fertilisers of different types and forms.

Plants have the ability to use the energy from the sunlight to join together carbon dioxide and water to make sugar. The process is known as photosynthesis and takes place in all green plants. To make the process work, the plant requires a number of essential nutrients, most of which are obtained directly from the soil.

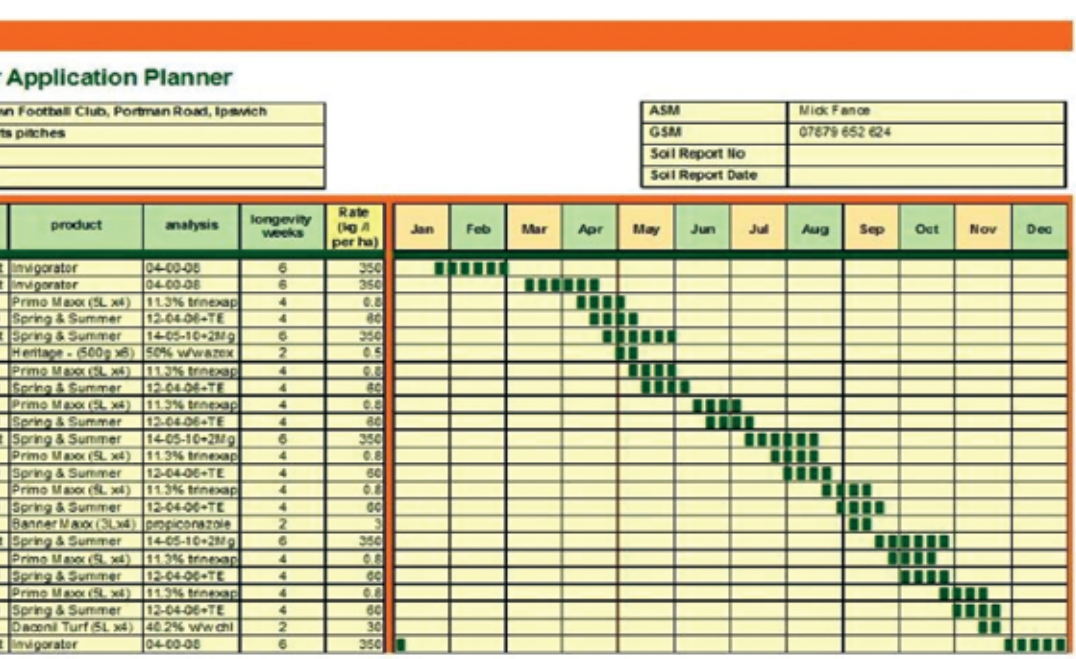
Plants require individual nutrients in different amounts. Most soils contain enough of the nutrients for healthy plant growth without additions being made. However, some nutrients are required in such large quantities that additional applications must be given if maximum growth is to be stimulated.

iTurf Fertilizer Application Planner

Client	Ipswich Town Football Club, Portman Road, Ipswich
Turf Area	Winter sports pitches
Area Size	7,000
Date	21/08/2008

ASM	Mick Fance
GSM	07879 652 624
Soil Report No	
Soil Report Date	

application no	application month	brand	product	analysis	longevity weeks	Rate (kg /l per ha)
1	Jan	Greenmaster Pro-Lit	Invigorator	04-00-08	6	350
2	Mar	Greenmaster Pro-Lit	Invigorator	04-00-08	6	350
3	Apr	Primo Maxx	Primo Maxx (5L x4)	11.3% trinexap	4	0.8
4	Apr	Greenmaster Liquid	Spring & Summer	12-04-06+TE	4	60
5	Apr	Greenmaster Pro-Lit	Spring & Summer	14-05-10+2Mg	6	350
6	Apr	Heritage	Heritage - (500g x6)	50% w/w azox	2	0.5
7	May	Primo Maxx	Primo Maxx (5L x4)	11.3% trinexap	4	0.8
8	May	Greenmaster Liquid	Spring & Summer	12-04-06+TE	4	60
9	Jun	Primo Maxx	Primo Maxx (5L x4)	11.3% trinexap	4	0.8
10	Jun	Greenmaster Liquid	Spring & Summer	12-04-06+TE	4	60
11	Jul	Greenmaster Pro-Lit	Spring & Summer	14-05-10+2Mg	6	350
12	Jul	Primo Maxx	Primo Maxx (5L x4)	11.3% trinexap	4	0.8
13	Jul	Greenmaster Liquid	Spring & Summer	12-04-06+TE	4	60
14	Aug	Primo Maxx	Primo Maxx (5L x4)	11.3% trinexap	4	0.8
15	Aug	Greenmaster Liquid	Spring & Summer	12-04-06+TE	4	60
16	Sep	Banner Maxx	Banner Maxx (3Lx4)	propiconazole	2	3
17	Sep	Greenmaster Pro-Lit	Spring & Summer	14-05-10+2Mg	6	350
18	Sep	Primo Maxx	Primo Maxx (5L x4)	11.3% trinexap	4	0.8
19	Sep	Greenmaster Liquid	Spring & Summer	12-04-06+TE	4	60
20	Oct	Primo Maxx	Primo Maxx (5L x4)	11.3% trinexap	4	0.8
21	Oct	Greenmaster Liquid	Spring & Summer	12-04-06+TE	4	60
22	Nov	Daconil Turf	Daconil Turf (5L x4)	40.2% w/w chl	2	30
23	Nov	Greenmaster Pro-Lit	Invigorator	04-00-08	6	350



General Advice:

This Recommended Application Report (the "Report") is offered as a free service by Scotts International BV to demonstrate hypothetical growing results achievable under standard growing conditions based on specific assumptions (the "Recommendations"). Product should be stored and all applications of Product should be performed according to label instructions. As circumstances can widely differ, your actual results may vary from those set forth in the Report. Therefore we suggest that the Recommendations herein are first tested by applying the resulting formulation to an inconspicuous but representative area of turf. Scotts International BV makes no warranty, express or implied, concerning the Report or the Recommendations and expressly declines all liability resulting from harm to persons or property which may result from reliance on these Recommendations.

Above: Soil analysis is vital if the corect programme is to be implemented

The major nutrients

There are three major nutrients that are required in large quantities by plants, namely, nitrogen, phosphorus and potassium, and a further three minor nutrients that are required in smaller, but significant amounts; these are calcium, copper, zinc, boron and molybdenum.

Most of the micronutrients are involved in some way in the production of enzymes, although some are also used as catalysts to directly speed up chemical reactions.

The major and minor nutrients and their functions are as follows.

Nitrogen Symbol N	This is one of the three major nutrients required by plants. It is used to increase the size of leaves, and stimulate overall growth.
Phosphorus Symbol P	Phosphorus is another of the three major nutrients. It is used transferring energy around the plant, and encourages development of roots.
Phosphorus Symbol K	Potassium is the third major nutrient, it affects the flowering process of plants and assists the regulation of water loss from the leaves.
Calcium	Calcium is found in large amounts within the plant, and is used in the development of healthy cell walls.
Magnesium	This nutrient helps to make the plants green, and affects the movement of certain nutrients around the plant.
Sulphur	This is used in the production of complex acids and oils within the plant.

Types of fertilisers

As mentioned above, the majority of soils will contain adequate nutrients for healthy growth, and it is only nitrogen, phosphorus and potassium that normally need to be added to soils. These nutrients can be given in different forms, and it is now possible to control how fast the nutrients become available to the plant.

Quick release fertilisers

It is now possible to control the rate at which fertilisers become available to the grass. Quick release fertilisers are chemicals which become available over a very short time. They are usually manmade materials, for example sulphate of ammonia. This type of fertiliser is normally applied during the growing season and is used when you want to encourage rapid growth.

Slow release fertilisers

Slow release fertilisers are chemicals which release their nutrients over a relatively long period. Some, such as hoof and horn and bone meal are natural organic materials which release their nutrients as they rot down. Man –made slow release fertilisers, or controlled release as they are often called, are specially made to release their nutrients throughout the growing season. An example of a controlled release fertiliser is isobutylidene diurea or I.B.D.U. for short.

Slow release fertilisers are usually applied in spring and are used to encourage steady growth. They can be bought as either liquids, granules or powders. Granules are the standard type, and consist of small round balls of fertiliser, which are easy to apply.

Liquid fertilisers come as concentrated solutions which must be diluted before use. They are sprayed on to the turf, and can cause scorching if applied during hot sunny weather.

Powdered fertilisers are less common than granules and they are made of very fine particles. On large sites they are not as easy to apply as granules, especially if the weather is windy. To aid application of this type of material you can mix it with an insert carrier, such as dry sand, and work it into the sward using a Tru–lute.

Fertiliser distributors

Fertiliser distributors are used widely in turf culture for spreading fertiliser evenly and efficiently. Any distributors should be able to carry out the following functions:

- Able to spread both granular and powdered fertiliser at a wide range of application rates
- The application rate should be easily adjustable
- They may be adaptable to sow grass seed and apply topdressing
- They should be designed and built in a way that will reduce corrosion as far as possible.

Spinning disc distributor

These machines are available in both pedestrian or tractor mounted versions. In most cases the tractor mounted will be used on football pitches.

The fertiliser is contained in an inverted conical shaped hopper and spreader in a wide arc by a horizontally rotating disc driven by land wheels. The fertiliser is fed to the centre of the disc by gravity. An agitator in the base will help prevent blocking and improve distribution.

The spinning disc distributor has a wide distribution width and is therefore a quicker method of applying a fertiliser.

This type of distributor requires a careful operator to ensure an even spread. Less fertiliser is placed towards the sides of the distribution width, therefore a certain amount of overlapping is required. It is fair to mention that some of the latest models of the spinning disc distributors have design features that help to compensate for the problem of uneven placement. Variation in distribution width is produced by a change in forward speed or a change in the material used.

The spinning disc distributor is rather difficult to calibrate accurately. One method is to place a one metre square of corrugated cardboard on the surface. When the distributor is passed over the sheet the fertiliser can be collected and weighted. Any necessary adjustment can be made by altering the slide in the base of the hopper until the correct calibration is achieved.

Remember that different materials will have a different flow rate and require recalibration

Maintenance of distributors

Corrosion of distributors can occur very easily due to the chemical action of the fertiliser if it becomes damp. This can result in replacement of parts, which is unnecessary cost. A wide range of distributors use of plastic, rubber and fibreglass to try and prevent corrosion. It can be kept to a minimum by taking the following precautions:

- All traces of fertiliser should be cleaned from the machine after use
- Fertiliser should not be left in the machine over night
- The distributor should not be left outside when not in use
- At the end of the season all working parts should be stripped down and thoroughly cleaned
- If any parts are worn they should be replaced so that the distributor is ready for use at the start of the following season.

Fertiliser application

Using disc distributors tend to apply more to the centre of the distributors width. To avoid uneven placement the machine is calibrated to half the rate required. If the machine is then used in the pattern indicated it would supply the correct rate by passing the whole site twice.

Fertiliser spreading

Any grass area will, from time to time, have to be fed. The size of area to be fed will determine the type of applicator to be used.

On most multiple pitch situations the spreader will probably be tractor mounted like the picture on the left. The cone shaped spreader will hold around 8 bags of fertiliser at a time. The pitch area can then be marked out allowing the fertiliser to be spread on evenly.

Care must be taken with such spreaders not to damage the agitator where the fertiliser will pass out.It is also advisable not to spread in windy conditions. The inside of the spreader should be kept dry.

Notes

Seeding

Introduction

At some point of a renovation it will be necessary to apply seed. This can be done by various methods. Features such as disease resistance, shade tolerance, colour, shoot density and wear tolerance should be taken into account. It is a good idea to speak to one of the seed houses that have people that can advise on such matters.

Seed sowing

The two most common mechanical methods of seeding in football pitch maintenance are over seeding and direct drill seeding. The latter is probably the favoured option for use during the close season renovation when groundsmen have a bit more time to establish a sward.

When drill-seeding groundsmen look to sow the seed in a manner that will encourage a tight knit sward to develop. Most direct drill machines sow the drills at 100mm (4 inch) centres. The machine then has to pass several times over the pitch in different directions to give the new grass a chance to knit together. The machine shown in the picture is the verti–seed. The verti–seed can sow drills in at 35mm centres. This means that in one pass the total amount of seed can be applied. The advantage of this is that the tractor does not have to keep running over the drills from previous runs. One impressive feature of the machine is the way it drops the seed into the drill having first cut it open. The machine also has the ability to close the drill over again to protect the new seed. The big advantage of the seed being in the drill is that it will produce stronger plants. This will also help to protect the plants against potential bird damage. It is sometimes necessary to seed in the season. Groundsmen will always look to minimise surface damage if this has to been done in the season. One method of doing this is to over – seed. Over seeders usually have a roller on the front of them fitted with short spikes? These insert hundreds of holes into the ground. The seed is then dropped out of the hopper and into the holes. The take up of seed is not usually as good as direct drilling but can still be reasonably successful if done properly.

Direct drill seeding

This is when the seed is drilled below the ground. Such machines that carry out this work usually cut a groove in the sward dropping the seed in behind the cutting disk. The groove is then closed over. Seed sown in this manner generally produces a stronger plant. Pitches are drilled in two or three directions. The depth of the drills is approx 5mm.

Left: The under side of the verti seed.

Over seeding

Machines are usually fitted with a roller with small spikes attached. This roller precedes the seed box Once the holes are made the seed drops out the back of the box into the holes. This method is preferred if seed has to be applied during the season.

Broadcasting

This is the traditional method. It is not accurate because of the difficulty in spreading the same width over a long time.

Seed mix

The seed mix should consist of at least three cultivars. The cultivars should ideally be dwarf perennial rye grass. Care should be taken when selecting the cultivars that compliment each other.

Left: Sisis overseeder in action

Notes

Top Dressing

Introduction

Top-dressing is carried out for a number of reasons;

- to regain surface levels
- to improve soil structure
- to improve surface drainage
- to aid the application of some fertilisers (as a carrier)
- to improve moisture retention (light soils)
- to improve nutrient retention (light soils)

It is only rarely that football pitches will be constructed from new on specifically designed soil profiles. It has generally been the case that football pitches were marked out on indigenous soils and were then improved afterwards by soil amelioration. Top-dressing is a form of soil amelioration when employed in conjunction with hollow tine spiking (coring), referred to as soil exchange.

Methods

Where aeration is employed on football pitches to improve the surface, 60 to 100 tonnes of sand can be applied at any one dressing.

Suitable sands (medium sands) range from a particle size of 0.125mm to 1mm (whose principle particle range is between 0.25mm and 0.75mm) for amelioration and top-dressing of football pitch surfaces.

It is essential where sand slit or sand injection drainage systems have been installed that the surface of the football pitch receives regular sand top dressings, usually about 100 tonnes per annum.

Sand construction (specifically designed soil profile) football pitches can require up to 100 tonnes of top-dressing per annum.

Measurements for sand

1.8 tonnes = 1m³ sand (damp – as delivered) will cover, at a depth of:

1mm = 1000m²	**6mm = 166m²**
2mm = 500m²	**7mm = 143m²**
3mm = 333m²	**8mm = 125m²**
4mm = 250m²	9mm = 111m²
5mm = 200m²	10mm = 100m²

(bold type indicates usual application rates)

Therefore on a typical pitch, 100m x 70mm (7000m²), to achieve an even depth of sand use the figures below to find tonnage or cubic metres needed.

Depth	M³	tonnes
1mm	7	12.6
2mm	14	25
3mm	21	37.8
4mm	28	50.4
5mm	**35**	**63**
6mm	**42**	**75**
7mm	**49**	**88**
8mm	**56**	**100.8**
9mm	63	113.4
10mm	70	126

(bold type indicates usual application rates)

Renovation

There was a time when the renovation of a pitch was confined to the close season. With many clubs now running various forms of youth set ups and staging other events grounds staff are now finding pitches are required most of the year. This has created problems when scheduling close season works.

Most pitches need at least nine weeks to recover and for new swards to mature ready for play.

Clubs that have youth set ups really need to have a minimum of eight pitches to allow the groundsmen to rotate the pitches. This rotation system can allow pitches to be taken out of use during the close season and be renovated.

With to days equipment renovation time can be shortened to 3 to 4 days and the choice of equipment, that is available to the groundsmen has never been so good. Renovations normally contain several elements such as scarifying, top dressing, aerating, seeding or some other form of turf maintenance.

Having carried out a number of renovations I feel that it is important to identify firstly what has to be done.

This assessment should be made well before the end of the season in order for the right equipment and materials to be obtained.

It may also be necessary to plan games or training on other pitches while the work is being done.

Left : Removing all the dead grass and debris ready to renovate.

Above: A top dresser fitted with a drop brush. This is ideal for concentrated dressings.

Scarifying

Most renovations start with the existing sward being cleaned out. This is usually done by employing the use of a scarifier. Most of these machines are now tractor drawn as shown in the picture above.

The debris is removed from the base of the sward by tines rotating at high speed. The debris is thrown up into a hopper. The advantage of the hopper is that it enables the groundsman to remove debris as the machine passes over the pitch as well as covering quite a bit of ground before emptying into a trailer or skip.

The machine can pass over the pitch on two or three occasions, or more if required.

The other purpose of the scarifying is to open the top ready to receive new materials. If using multiple passes they should be done at an angle but never at right angles.

Left: A level lute starts to address surface levels.

Top dressing

It is important when top dressing to select both the correct material and the correct equipment. Many mistakes are made in the selection of both. Firstly the materials should ideally be compatible with what is already in the root zone. This can be determined by having both the existing and new material analysed. The resulting particle size analysis will tell if both are compatible. The danger if they are not can lead to a layer forming in the upper root zone or the surface becoming loose because of the incompatibility of the new root zone.

The new materials should be applied evenly over the pitch before being worked in by brush or lute. When working in the new materials it is important to do this in several directions in order to pick up the new levels. This can be achieved by brushing or by using a bar level or lute. Whatever implement is being used it is important to travel over the pitch at a sensible speed in order to allow the material to be worked in properly. Material can also be worked in by the use of drag mats. These can be single or towed in groups of three.

Right: Hollow cores being brought on to the surface ready to mix with sand that has been dressed on. Mixing the cores and sand dressing together can prevent layering and help integration.

Aeration in renovations

It is almost certain that after working the new sand into the top surface the pitch will need to be aerated to help integrate the new material in to the upper root zone. This can be done by either solid tining or if a more thorough integration is sought the pitch will be hollow cored. If solid tining is the option there is a choice of the verti drain or the Wiedenman or maybe the Huxley Soil Reliever. Any of these machines will insert a hole in the pitch down to a depth of 350mm (14 inches). These machines can carry a variety of tine options from ½ inch (12mm) to ¾ inch (17mm) on the big machines. Smaller models can be fitted with special multiple tine options. This is sometimes referred to as mini tining. A number of machines can carry out hollow coring. Coring tines can come in a number of diameter sizes and can be fitted to give a concentrated pattern or a more standard ½ inch (12mm) or ¾ inch (17mm) pattern.

Above: Deep coring tines have allowed more material to be brought on to the surface for ameilioration

Left: A verti drain with pencil tines gives other options at renovation time

Deep hollow coring

The most important thing when applying a large amount of top dressing is to get it through the top surface. How successful you are in doing this will determine whether you have trouble the following season with layering or shear planes.

For some time now groundsmen have hollow cored. This has been usually to a depth of 100mm (4 inches).

The machine shown in the picture is fitted with deep coring tines capable of achieving depths down to 250mm (10 inches). When working, the rear roller lifts up and can be fixed so that the cores do not get flattened.

The heave normally applied during solid tining can be locked, allowing the tines to enter and exit the surface vertically.

Spacing as close as 100 x 100 mm (4insx4ins) to depths of up to 12 inches (300mm) allows a massive amount of root zone material to be brought up on to the surface for amelioration with new material. This allows the entire top root zone to be freshened up at the time of renovation.

Re-cycling of cores

A popular method of modern day renovation is to ameliorate, or mix, existing root zone with new material. This is done by firstly applying new materials in a bulky dressing. This can be sand or a pre mixed root zone. Volumes of bulky dressing can vary depending on the surface condition at the time of renovation. Average dressings are usually in the region of 50 to 60 tons.

Once applied the surface is hollow cored. By coring, existing materials is brought up onto the surface. The size of core will depend on the choice of tine but any coring tine 13mm to 17mm will produce as much as another 30 to 40 tons. Having cored the pitch the cores and the bulky dressing need to be ameliorated (mixed). A number of recycling machines are available on the market today enabling the surface mix to take place. It may be necessary to pass over the pitch more than once depending on the moisture of the core at time of re cycling.

Once the thatch top of the core has been removed and the bulky dressing and the core properly integrated the pitch surface can be drag matted to re - establish surface levels. The remains should be swept from the surface prior to seeding .Good integration will prevent layering, which could lead to root break in the top 100mm causing serious divoting later in the season.

In order to get maximum benefit from the amelioration the selection of the re-cycling machine is important. The machine pictured is the core re–cycler from Greensward. It should also be remembered that whatever machine is selected the amelioration should be carried out in dry conditions. This will allow the material to be lifted and mixed. The Greensward re–cycler is carried on the three point linkage and is PTO. (540) driven. The PTO (power take of) drives a brush against the direction of travel lifting the cores and the new material up off the ground into the machine. The cores and the material are then shredded against a mesh separating the grass and the soil form the core. The new mix then falls to the ground. If the coring has been heavy it may be necessary to pass over the area more than once. The aim should be to leave a dressing lying on the ground

ready to be brushed in. During brushing the tufty deposit is left on the top while the mixed material falls down the aeration holes. The re–cycler should be operated in a low gear to allow the machine time to do its job. If this process is carried out correctly it will prevent layering of the new dressing.

Core harvesting

When carrying out coring work it is often good to remove the cores from site. As you can imagine on an area the size of a football pitch this can be quite a task. In days gone by all that was available to the groundsmen was a shovel and barrow. Now we are lucky to have equipment such as the Cushman Core Harvester. The machine as its name suggests is an all in one harvester. Fitted as an attachment to the Cushman Truckster System it allows the groundsmen to collect the cores and dispose of them in one operation. Large areas can be tackled in a matter of hours leaving a clean top for other operations to take place.

Seeding in renovations

After passing scarifiers and aerators through a pitch during a renovation the sward will have taken a fair beating. Much good will have been done and in order to round of a good renovation it is essential to get the seeding element correct.

The aim of the seeding element of the renovation should be to introduce strong new cultivars of rye grass perhaps being mixed with a base grass such as creeping fescue or tufted hair grass. Any good seed house will be able to give help in putting together a mix for a specific venue.

Having selected the seed mix the next thing is to make sure the seed is going to be sown correctly. Ideally the seed should be drilled into the top of the pitch to a depth of no more than 5mm.This will always produce a strong plant as the seed is protected in its early days by being under the ground out of view of birds and other animals that would feed on the seed. By the time the shoot appears above the ground some 5 to 6 mm in length it will have the same or more in root to support it. This root and shoot development has to be encouraged as it can make or break the condition of the pitch for the next season. Any new seed bed will require a decent water supply to ensure a good germination. The seed bed should be kept moist and care should be taken not to over water.

Left: The verti seeder gives very close centre drills ideal for producing a tight sward

A Ryan junior turf cutter

Getting the bed level is important

Slabs being laid. Note the boarding out of the existing goal area

Turf should be laid in brick fashion to avoid drying out

Goal mouth re-instatement and maintenance

With ever increasing demands on both stadium and training pitches it is inevitable that key areas such as goal mouths will wear quicker. Coaches and players in today's game will no longer tolerate the mud baths of yester year. A popular method of renovation is re turfing by slabbing. The method is quick and play can recommence within a couple of days.

It is important when carrying out such a reinstatement that the turf coming out is the same thickness as the turf coming in. Checks should also be made to ensure that the incoming turf is compatible with the existing sward. The objective of the job should be to provide players with a good level such as they had prior to the goal wearing. It is easier if the new turf can come from an area on the site as this should help with the compatibility. A Ryan Turf Cutter is an ideal machine to do such a job as a constant depth can be maintained. A good depth to work at is 40mm. You will find turves cut thicker will be to heavy to handle. After cutting the turf all debris should be removed from the turf bed ready for re-laying. The level should be checked . The bed should also be firm. If the nursery is to be on the same site it should be maintained in exactly the same manner as the rest of the pitches. Once the turf has been cut the area should be reseeded with the same mixture again to maintain the continuity.

Once the new turf has been cut it can be transported to the site in either rolls or slabs. The first turf should be laid in to the bed working from one edge. Care should be taken not to step on to the prepared area to ensure the bed levels remain intact. As an extra safeguard for the new turf boards can be used for walking on. The turves should be laid in from the edge overlapping in the middle to build up the rows in brick fashion. This will help to knit the new turves in and lessen the risk of drying out along the edges.

Turf should be tapped gently to level after laying

After laying each row the turves should be gently tapped to level. The turves should also be butted up tight together to prevent them drying out. Excessive beating will bruise the leaf. Turf beaters such as the one shown are ideal although the back of a rake can also be used to good effect.

Once laid a light dressing should be applied along the joints

Having laid all the turves into the area they should then be top dressed. A good rootzone or sand should be used and care should be taken to ensure that it is compatible with the existing material in the goal mouth. Because it is a small area spreading can be done by shovel from a trailer. Once spread the sand or rootzone should be worked in using a broom or rubber rake. The dressing should be enough to fill any gaps in the joints between the turves.

A seed slotter can create hundreds of holes for introducing new seed

Renovations can also be done by hand if the wear does not justify full re-turfing. Tools such as those shown in the picture on the left can carry out effective maintenance. A series of holes can be inserted using a seed slotter. Seed can then be spread over the area by hand and raked in using a rubber rake. Germination can be boosted by the use of germination covers or polythene frames.

During the winter months it will be necessary at some point to have to fork goal mouths to relieve surface water caused by heavy rain. As goalmouths are always going to suffer from local compaction this water will be slow to clear. Provided the areas are forked in the proper manner effective maintenance can be carried out. Care should be taken not to insert too many holes as this can de stabilise the area.

Reducing foot damage

Care should also be taken not close the holes already inserted. Forking should be done from a board at all times. This reduces foot damage in the goal area as shown in the picture on the left.

Walking a pitch on the mower pattern

A turf doctor and mallet

A damaged area of turf is removed ready to be replaced by new turf

Outfield re-instatement

In order to maintain the levels on any playing surface it is important to carry out a full re instatement following a game. This process can never be a quick one if the job is to be done properly. Having said that some new constructions are designed not to divot but in achieving this the surface is sometimes deemed too hard.

In the majority of senior pitches the nature of the construction of the root zone will see some damage. Divoting or knocking back as it is sometimes referred to is probably the most boring job done by groundsmen but also probably the most important. Although best done by a team of people, finer reinstatement of smaller damage is often achieved by one or two people working on a defined area such as one wing. Strings or stripes created by the mowing pattern can be used as guides so as to ensure all the area is walked over and no damage is missed. It can take up to four days to cover a pitch although on a bad day it can take longer.

Some types of footwear worn by the players can cause damage to the surface. When the damage is too great to be reinstated by the use of forks, turf tools can be used to remove the area of damage totally and transfer in a new block of turf. Turf blocks can be put in as singles or doubles or any other multiples to cover the affected area.

A tool that can be used for this is the Turf Doctor. The Turf Doctor has four sides to it. The sides are in the form of plates, which are hammered in to the ground using a rubber mallet. Each plate is hammered in to a set depth to ensure that when all four are in the ground an evenly cut block is taken. It is important that when turfing in several blocks at a time the blocks are level so the finished level matches that of the pitch around it.

Notes

Health and Safety

The following information is only meant as a guide. Updates should be sought on a regular basis from the Health and Safety Executive.

The following is a short synopsis of the Health & Safety Legislation relevant to the work place.
You should be aware of their contents and keep yourself up dated with changes.

HEALTH AND SAFETY AT WORK ACT, 1974 (AND AMENDMENTS).

The general duties of employers' are wide-ranging and comprehensive and cover all people who are 'at work' whatever there works location. Some of the duties contained in the 1974 Act and other legislation are '**absolute**' and must be complied with, while others are qualified by the phrase '**so far as is reasonably practicable**'. This phrase means that the duties are limited to ensure that the amount of effort, time and expense involved is proportionate to the risk. Therefore, work activities that pose a high risk to employees or other persons, such as the public, require a correspondingly high degree of effort to ensure that those risks are controlled. Conversely, those work activities that pose a slight or low risk should require a lesser degree of effort and time to control. If the phrase is not qualified by the term 'reasonably' then a higher standard would be applied in which the cost, time and trouble involved in controlling the activity would not be taken into account.

If a prosecution is taken against a person for failing to comply with a duty, that person must prove that it was not '**reasonably practicable**' to carry out more than what was already being done. The onus of proof in this case is on the accused.

The general duties are, as the term suggests, very broad in their application and the Act itself provides no guidance as to the exact interpretation to be applied. Guidance is, however, provided in the form of Regulations, Approved Code of Practice (AcoPs) and Guidance Notes.

Employer's main duties:

- Provide and maintain plant and systems of work that are safe and without risk to health
- Ensure safety and absence of risk with the use, handling, storage and transport of articles and substances
- Provide information, instruction, training and supervision for Health & Safety of all employees
- Provide suitable personal protective equipment (PPE) free of charge
- Provide and maintain safe access to and exit from all places of work
- Provide and maintain adequate Welfare provision (see definition)
- Provide and review a written Health & Safety Policy Statement.

Employee's main duties:

- Take care of themselves and others (other workers, contractors, general public, visitors) while at work
- Co-operate with any requirement to maintain Health & Safety at work
- Do not interfere with or misuse anything provided for Health, Safety or Welfare at work.

Definition: welfare

- Clean drinking water, protective clothing, toilet provision, washing provision, eating and sitting provision, storage for personal and protective clothing and protection for eyes and ears.

MANAGEMENT OF HEALTH AND SAFETY AT WORK REGULATIONS, 1999

Employer's main duties:

- Assess the risk to Health and Safety of employees and others
- Plan, organise, control, monitor and review measurers taken as a result of the risk assessment
- Maintain health records where required
- Appoint 'competent persons' to comply with statutory obligations
- Establish appropriate emergency procedures
- Provide information on possible hazards and the measures taken to reduce risks
- Provide comprehensive information to temporary employees and volunteers on health and safety
- Consider the capabilities of employees to comply with health and safety requirements
- Co-operate and co-ordinate with other employers on shared places of employment.

Employee's main duties

- Use any equipment provided to them in the interest of health and safety
- Follow all appropriate instruction and training given in the use of equipment provided.

HEALTH AND SAFETY (YOUNG PERSONS)

Definition: Young persons: from minimum school leaving age to 18 years

Employer's main duties:

- take particular account of the immaturity, lack of experience and awareness of existing or potential risks of young workers (see Definition)
- carry out risk assessments before young persons begin work
- Take account of the risk assessment in determining whether the young person is prohibited from doing certain work
- where work is necessary for the young persons (those over school leaving age) training, ensure they are properly supervised and all risks are reduced to the lowest practicable level
- inform parents or guardians of the outcome of the risk assessment and the control measurers to reduce the risk

Young people may be prohibited from doing work which:

- is beyond their physical or psychological capacity;
- involves harmful exposure to radiation or agents (toxic, carcinogenic etc);
- in any way chronically affects human health;
- involves the risk of accidents which may not be recognised or avoided by young
- people by virtue of their inexperience
- involves a risk to health from extreme cold, heat, noise or vibration

PROVISION & USE OF WORK EQUIPMENT REGULATIONS 1998 (PUWER 98)

Employers main duties:

The Regulations require risks to people's health and safety, from equipment that they use at work, to be prevented or controlled. In addition to the requirements of PUWER, lifting equipment is also subject to the requirements of the Lifting Operations and Lifting Equipment Regulations 1998 (see following section on LOLER).

What does PUWER do?

In general terms, the Regulations require that equipment provided for use at work is:

- suitable for the intended use;
- safe for use, maintained in a safe condition and, in certain circumstances, inspected to ensure this remains the case;
- used only by people who have received adequate information, instruction and
- training;
- accompanied by suitable safety measures, e.g. protective devices, markings, warnings.

You must ensure that the work equipment you provide meets the requirements of PUWER. In doing so, you should ensure that it is:

- suitable for use, and for the purpose and conditions in which it is used;
- maintained in a safe condition for use so that people's health and safety is not at risk;
- inspected in certain circumstances to ensure that it is, and continues to be, safe for use.
- **Any inspection should be carried out by a competent person (this could be an employee if they have the necessary competence to perform the task) and a record kept until the next inspection.**

You should also ensure that risks, created by the use of the equipment, are eliminated where possible or controlled by:

- **taking appropriate 'hardware' measures, e.q providing suitable guards, protection devices, markings and warning devices, system control devices (such as emergency stop buttons) and personal protective equipment; and**
- taking appropriate 'software' measures such as following safe systems of work (eq ensuring maintenance is only performed when equipment is shut down etc), and providing adequate information, instruction and training.

Mobile work equipment

In addition to these general requirements, which apply to all work equipment, Part III of PUWER contains specific duties regarding mobile work equipment, for example forklift trucks, tractors, mowers and other vehicles. You should ensure that where mobile work equipment is used for carrying people, it is suitable for this purpose. Measures should be taken to reduce the risks (e.g. from it rolling over) to the safety of the people being carried, the operator and anyone else, this may involve the use of roll over protection and in some cases seat belts.

LIFTING OPERATIONS AND LIFTING EQUIPMENT REGULATIONS 1998 (LOLER 98)

The Regulations aim to reduce risks to people's health and safety from lifting equipment provided for use at work. In addition to the requirements of LOLER, lifting equipment is also subject to the requirements of the Provision and Use of Work Equipment Regulations 1998 (PUWER).

What is lifting equipment?

Typical examples are:

- cranes
- fork lift trucks
- tractor front loaders
- elevated work platforms
- vehicle lifts
- Jacks
- accessories, such as; chains, lifting slings, shackles, eye bolts

What does LOLER do?

Generally, the Regulations require that lifting equipment provided for use at work is:

- strong and stable enough for the particular use and marked to indicate safe working loads.
- positioned and installed to minimize any risks;
- used safely, i.e. the work is planned, organized and performed by competent people;
- subject to ongoing thorough examination and, where appropriate, inspection by competent people.

What do the regulations require an employer to do?

You need to ensure that in using any lifting equipment the requirements of LOLER are met.

For example, you should ensure that all lifting equipment is:

- sufficiently strong, stable and suitable for the proposed use. Similarly, the load and anything attached (e.g. timber pallets, lifting points) must be suitable;
- positioned or installed to prevent the risk of injury, e.g. from the equipment or the load falling or striking people;
- visibly marked with any appropriate information to be taken into account for its safe use, eg safe working loads. Accessories, e.g. slings, clamps etc, should be similarly marked.

Additionally, you must ensure that:

- lifting operations are planned, supervised and carried out in a safe manner by people who are competent;
- where equipment is used for lifting people it is marked accordingly, and it should be safe for such a purpose, e.g. all necessary precautions have been taken to eliminate or reduce any risk;
- where appropriate, before lifting equipment (including accessories) is used for the first time, it is thoroughly examined. Lifting equipment may need to be thoroughly examined in use at periods specified in the Regulations. (i.e. at least six-monthly for accessories and equipment used for lifting people and, at a minimum, annually for all other equipment) or at intervals laid down in an examination scheme, drawn up by a competent person. All examination work should be performed by a competent person;
- following a thorough examination or inspection of any lifting equipment, a report is submitted by the competent person to the employer to take the appropriate action.

THE MANUAL HANDLING OPERATIONS REGULATIONS 1992

25 – 30% of all reportable accidents can be attributed to manual handling operations.

Employers duties:

- Avoid the need for hazardous manual handling, as far as is reasonably practicable
- Assess the risks of injury from any hazardous manual handling that can't be avoided
- Reduce the risk of injury from hazardous manual handling
- Follow systems of work laid down for their safety
- Make proper use of equipment provided for their safety
- Inform the employer if they identify hazardous handling activities
- Take care that their activities do not put other at risk

Ways in which manual handling risks can be reduced:

- avoid manual handling (use mechanical handling, fork lift or tractor loader)
- use handling aids where possible (sack trucks, pallet trucks, lifting bars)
- get trained in safe handling techniques
- practice safe handling methods

THE WORKPLACE (HEALTH, SAFETY AND WELFARE) REGULATIONS, 1992.

Employer's main duties:

- maintain workplaces, equipment, devices and systems efficiently and in good repair
- maintain effective ventilation for enclosed workplaces, with warning devices
- provide thermometers and effective temperature control in all workplaces
- provide suitable and sufficient lighting in all workplaces
- maintain clean workplaces and ensure removal of all waste materials
- provide adequate floor area, height and space in accordance with the regulations
- provide suitable workstations for employees and the nature of work undertaken
- provide safe floors on 'traffic routes' (see definition below)
- provide fences, covers and other safety precautions to prevent persons or objects falling in the workplace
- provide safety material or protection against breakage of windows and other transparent surfaces in the workplace
- provide safe and adequate traffic routes in the workplace with separation of vehicles from pedestrians
- ensure the safe construction of doors and gates
- ensure escalators/walkways function safely, have safety devices and are provided with one or more emergency stop controls
- provide rest rooms/ areas free from tobacco smoke.

Employee's main duties

- inform the employer of any work situation, which represents a serious and immediate danger to health and safety

Definition: traffic routes

- any route for pedestrian traffic, vehicles or both, stairs, staircases, fixed ladders, doorways, gateways, loading bays or ramps.

THE PERSONAL PROTECTIVE EQUIPMENT AT WORK REGULATIONS, 1992

Employer's main duties:

- suitable personal protective equipment (PPE) is provided in the absence of an equal or superior control measure or system
- take account of the ergonomic requirements of the user, it must fit correctly, be effective and comply with European Community (EC) Standards
- ensure all such equipment is compatible and effective
- carry out an assessment of all PPE prior to its use
- keep all PPE in effective working order
- store correctly all PPE when not in use
- provide comprehensive instruction, training and information on risks limited by PPE, and provide instruction on use and maintenance of PPE in good working order
- ensure the proper use of PPE.

THE HEALTH AND SAFETY (INFORMATION FOR EMPLOYEES) REGULATIONS, 1989

Employer's main duties:

- to provide their employees with information on health, safety and welfare at work, either by displaying an 'approved poster' or providing and 'approved leaflet'
- ensure the poster is displayed in a readable condition, is accessible to all employees, is easily seen and read by all employees and is the current approved version
- complete the poster with the address of the 'local enforcing authority' and the 'local employment medical advisory service' office

  or

- ensure the leaflet is the currently approved version
- provide with the leaflet the address of the 'local enforcing authority' and 'employment medical advisory service' offices

THE HEALTH AND SAFETY (FIRST-AID) REGULATIONS, 1981

Employer's main duties:

- to make provision for first-aid
- provide such equipment and facilities as are adequate to give first-aid to an employee who is injured at his place of work
- provide a suitable number of persons capable of rendering first-aid to injured employees
- inform employees of first-aid arrangements
- ensure employees are aware of the locations of first-aid equipment and the identities of 'firstaiders' and 'appointed' or 'competent' persons
- maintain records as appropriate.

THE ELECTRICITY AT WORK REGULATIONS, 1989

Employer's main duties:

- ensure that all electrical work is carried out as laid down in the Institute of Electrical Engineers' Wiring Regulations.
- test all portable electrical equipment at regular intervals
- test fixed installations every five years
- ensure that employees are adequately protected, i.e., special insulated tools, safety boots and residual circuit breakers.

The regulations require electrical systems be constructed and maintained at all times to prevent danger. This means protection from arcing, burns, electrical shock and explosion, for example, which may be likely to cause death or injury involving equipment.

THE NOISE AT WORK REGULATIONS, 1989

Employer's main duties:

- reduce the risk of hearing damage to employees to the lowest practicable level
- consider modifying machinery and equipment to reduce noise levels generated
- employ alternative, quieter machinery or equipment
- consider removing all non-essential personnel from noisy work areas.
- provide suitable hearing protection (ear defenders)

At the first action level (85 dB(A)):

- carry out a noise assessment
- provide employees with ear protection if requested
- provide relevant and appropriate information and training
- notify employees of their rights and obligations under the Regulations.

At the second action level (90 dB(A)):

- reduce employees exposure to noise by means other than ear protection, i.e., by fitting silencers to machinery
- provide all employees exposed to this action level and above with ear protection
- ensure all ear protection provided is properly used, maintained and repaired as necessary
- designate areas as 'ear protection zones' for this action level or above
- clearly label designated zones for compulsory wearing of ear protection
- keep all relevant records of assessment and review as required.

At the "peak action level" (140dB(A):

- take action to reduce the noise level

Employee's main duties:

- wear ear protection in areas where the second action level is reached
- wear ear protection at all times in designated protection zones
- ensure all protective equipment provided is properly used and maintained
- report any defective equipment to the employer.

THE CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH REGULATIONS 1999 (COSHH)

Employer's main duties:

- conduct a risk assessment before any work involving hazardous substances is undertaken
- (please note that an assessment carried out under the old 1988 Regulations, a 'COSHH Assessment' is now referred to as a 'Risk Assessment'
- take adequate steps to eliminate the risk or control it to a level, which will not be a danger to his employees.

Conducting a risk assessment can be broken down into 5 simple steps:

1. look for all the hazardous substances in the workplace
2. decide who might be harmed by the hazardous substances, and how
3. evaluate the risks and decide what can be done to minimise the risks
4. record your findings
5. review and update the assessment as and when necessary.

Note: The use of manufacturers safety data sheets (MSDS) for hazardous substances will make the task of carrying out risk assessments for hazardous substances much easier. These sheets should be provided by the manufacturer or supplier of the substance.

REPORTING OF INJURIES, DISEASES AND DANGEROUS OCURRANCES REGULATIONS, 1995 (RIDDOR)

Employer's main duties:

- notify any 'reportable' (see Definition) accident, injury, dangerous occurrence or case of disease in your workplace to the 'enforcing authority' (see Definition)
- keep records of all details
- appoint a 'responsible person' (see Definition) to undertake these duties

Definition: reportable

- death or major injury
- absent from work or unable to do their normal work for more than 3 days
- reportable work related disease
- dangerous occurrence.

Definition: enforcing authority

- the Local Health & Safety Executive (HSE) area office
- the Local Authority Environmental Health Department

Definition: responsible person

- the Employer
- the Manager
- the person in charge of operations at the site where the event occurred.

Notes

Surface Drainage

Introduction

Football pitches set out on indigenous soils of a heavy soil nature have to depend to a large extent on surface water 'run off'. This water would be collected by perimeter drains situated around the outside of the playing area or more usually left to filter through the soil and away from the playing area.

On older pitches piped drainage systems were laid under-ground with the backfill coming up to within 100mm of the surface and topped by a medium sand to the surface.

It is these older football pitches which invariably have sand, slit or sand injected systems (or both) installed over the existing piped drainage to facilitate adequate drainage of surface water today.

Installation

The installation of any drainage system today is not cheap therefore a thorough investigation must be carried out to establish possible alternatives, if any.

Look at the present maintenance regime to see if improvements can be made in areas such as thatch removal, spiking frequencies, top-dressing materials or soil exchange programmes.

Maintenance

Inspect any existing drainage systems for efficiency of operation, particularly outfalls and silt traps (inspection chambers).

Check the existing type of construction as it used to be a common practice to overlay backfill with a filtration membrane. This could have sealed over with silt preventing free movement of surface water into the underlying backfill over piped drains.

Notes

Maintenance Quotes / Specifications

Introduction

A specification details what is required to either achieve an objective or what the product is that has to be achieved.

The writing of specifications can be carried out from one of three approaches:

1. Performance based;
2. Frequency based; or
3. A hybrid of performance and frequency.

Performance based specification

This is where the end result is clearly stated. Measurable criteria are set, as standards, which have to be achieved by carrying out whatever tasks are necessary. The tasks are not stated in the specification (or not to any detail), this is left to the professional contractor or operator to determine how this can best be achieved and will need to take into account topography, soil conditions and local climate.

This type of specification may be more suited to where a client requires a high quality job, or product, and where cost, whilst important, is not the overriding factor. The benefit of this type of specification is that a fixed price is provided to achieve the overall quality of the desired product, helping with budget control.

The level of skill required to carry out this type of specification is high due to the dynamic thinking which is required by the operative/s.

Frequency based specification

This is where the person writing the specification determines the tasks and number of them, i.e. frequency, to maintain the chosen facility at the required standard.

There is a reliance in these specifications of ensuring that the person writing the specification fully understands what is required and has to take into account local conditions to prevent unnecessary damage being done if tasks are carried out in unsuitable conditions.

If the operative/s carrying out the work are not particularly skilled, this may be the best approach to carrying out the work because a performance based specification requires a much higher skill level. Alternatively, additional skills training may be an option.

This type of specification may be beneficial where costs are required to be kept to a minimum and the facilities are being maintained to a generally satisfactory level. There is no underlying reason why this type of specification cannot be used for the production of high quality facilities, however, a very good understanding, trust and flexibility has to exist between the specifier and the person carrying out the work.

A range of provisional operations may need to be specified to take into account the different situations which can arise due to varying soil and climatic conditions, making the specification potentially quite complex and also allowing for a large variation in the price of the work at the end of the year, depending upon what was actually carried out.

A hybrid specification combining parts of performance with frequency based specifications

This is where performance standards are required to be achieved by carrying out a stated task, with the frequency of tasks being estimated for achieving the required standards. This is arguably the commonest type of specification for grounds maintenance work.

An intermediate specification, however, a range of provisional operations may still need to be specified, allowing for a smaller variation in the price of the works.

Where there is a range of skills offered by operatives, this may be a good way of balancing those skills to achieve the objectives of the specification.

Standards are defined by British Standards as “acceptable or desirable values for those aspects of quality that can be defined and measured objectively”.

Examples of measurable standards which can be applied to turf include:

- Grass species content
- Weed, pest and disease infestation
- Total ground cover
- Root depth
- Thatch depth
- Grass length
- Hydraulic conductivity of the soil profile
- Quality of cut, e.g. bruising
- Evenness of the surface
- Speed of the ball on the surface; etc.

The tighter the tolerances chosen, the higher the standard and also the greater the maintenance and cost required to achieve. For example, ‘Grass height for fine ornamental lawns’ : If the lawn is to be maintained between the heights of 6mm and 9mm, this will involve more frequent mowing than if the lawn is to be maintained between 6mm and 12mm.

Quality

British Standards define ‘quality’ as the “totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs”. Once you have determined the criteria which make up each standard, this will then decide the level of quality which is being achieved, such as high, medium or low quality.

Operations and their description

After deciding which operation is required, unless it is a purely performance based specification which requires the standards to be laid out, you will need to describe exactly what is required in a clear and comprehensive yet concise way : This is not as easy as it initially seems.

The type of information which you may consider for inclusion within a description may include some of the following:

1. The suggested tool or machine;
2. The type of material, including any application rate;
3. When the work is expected to be carried out;
4. How many times you envisage the work needs to be done;
   Does the frequency of work differ with the changing seasons?
5. Any suggested depths of penetrating implements, along with the spacing required, e.g. aerating tines, say at 100mm depth and 50mm spacing. Alternatively, you may decide it is preferred to state the type of machine along with the technical specification
6. Any conditions in which the operation should not be carried out, e.g. heavy scarification in drought - otherwise an operative may carry out the work because instructions were not clear enough. This is one benefit of performance based specifications where skilled operatives are employed, because they would (or should) understand the technical requirements of maintaining turf
7. The direction of the operation, e.g. to give a striping effect, especially for mowing
8. Whether clippings are to be removed all, some or none of the time
9. Whether litter or debris needs to be cleared before an operation. You may decide it will only need clearing if it has reached a certain density
10. Whether any surface disturbance is permitted by undertaking the operation and if so, to what degree
11. Heights of operation, particularly for mowers. Should the grass be mown at a regular interval or when it has reached a height to within a certain percentage of its maximum defined growth height? It may be found that very fine turf, e.g. bowling greens, are mown on a regular basis throughout the growing season. Alternatively, grass which is mown at a longer height, e.g. football pitches, may be more effectively managed by mowing once the grass reaches a predetermined height
12. Where can refuelling take place? Certainly not on a fine turf area!
13. What level of evenness should be achieved from the application of a top-dressing material?
14. How are lawn edges to be formed? Straight edge, curve, by hand or machine? How much deviation from the line is to be permitted?
15. Is surface moisture, e.g. dew, to be removed before a certain time in the morning, e.g. 8 a.m.?

This is only a start, however, it should begin to give an idea of the sort of points which need to be considered.

Work programme

A work programme is normally completed by a contractor/operator as part of a specification and is returned to a client as part of a tender document. This will summarise all the operations that are to be undertaken to achieve the standards. It will also show to a prospective client how well the contractor/operator has understood what is required and how well the works have been integrated as part of the management process.

Example:

- usage is planned as 54 adult games for the season,
- the carrying capacity has been estimated as 60 adult games,
- an irrigation connection point is available, to which a travelling sprinkler can be attached,
- frequency and quantity of rainfall have been arbitrarily taken into account for this hypothetical site.

(Please note that the estimated times are only used to illustrate how labour profiling works. Groundstaff will need to put in their own particular figure. However, many of the times given will be fairly representative of a typical time to undertake the stated task on a football pitch).

	Time per operation (hours)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Weeks per month		5	4	4	5	4	4	5	4	4	5	4	4	52
Games per month		4	4	4	10	4	0	0	0	8	8	6	6	**54**
Task		(Estimated hours spent on each task per month and as an estimated total for the year.)												
Mow @ 35-50mm	0.5					2	2	2	2					**8**
Mow @ 25 -35mm	0.5			0.5	2	0.5			1	2	1.5	0.5		**8**
Initial Mark Out	4								4					**4**
Overmark	0.6	2.4	2.4	6	2.4					4.8	4.8	3.6	3.6	**32.4**
Aerate - Slit tine	1.1	1.1		1.1						2.2	2.2	1.1	1.1	**8.8**
Aerate - Deep spike	4					4								**4**
Top-dress & work - in: 40 tonnes	18					18								**18**
Overseed	1.5					1.5								**1.5**
Additional renovation	6							6						**6**
Maintain eveness	0.33	0.33	1.32	1.32	1.32	2.64	0.66				0.66	1.32	1.32	**10.9**
Occassional Diveting	0.2	0.4	0.4	0.4	1	0.4				0.8	0.8	0.6	0.6	**5.4**
Fertilise	1.5				1.5				1.5					**3**
Roll	1					1		0.25						**1.3**
Scatify	1					1								**1**
Chain harrow / brush	0.5	0.5	0.5	1	1	1				0.5	1	1	0.5	**7**
Irrigate	0.75					4.5	3	3	3					**13.5**
Selective Herbicide	2						2							**2**
Erect Goal Posts	4								4					**4**
Dismantle Goal Posts	2					2								**2**
Paint Goal Posts	3							3						**3**
Totals		4.7	4.6	6.7	12.8	40.9	7.7	14.3	15.5	10.3	11	8.2	7.1	**143.8**
Average hours per week		0.9	1.2	1.7	2.6	10.2	1.9	2.9	3.9	2.6	2.2	2.1	1.8	2.8

Cost of Materials

The exact cost of materials will vary depending upon a number of factors such as

- availability
- whether they are specialist or general materials
- the quality of the material, especially top-dressings
- location of the site for delivery from the supplier
- quantity of materials being purchased - discounts for large quantities.

If we take the maintenance calendar as a guide, the following costs might be incurred, for a pitch with an area of 6,000 m^2:

Material	Quantity and unit cost	Total cost: 2008
Renovation materials:		
Top-dressing	Say 40 tonnes required @ £40 per tonne	£1,600
Grass Seed	Applied @ 17g/m^2 = 4 x 25kg bags; @ £95 per bag	£380
Fertiliser	Applied @ 25g/m^2 = 6 x 25kg bags; @ £25 per bag	£150
Turf for goalmouths	6 yard (5.5m) x 8 yard (7.3m) = 40m^2	£320
Other materials:		
Top-dressing for remainder of year	Say 20 tonnes @ £40 per tonne	£800
Fertiliser	Applied @ 25g/m^2 = 6 x 25kg bags;@ £25 per bag	£150
Diesel for machines	£5.20 gallon x 40 gallons	£208
Turf tonic, (sulphate of iron)	At 4g/m^2, 1 x 25kg bag, @ £12.50 per bag	£13
Line marking material	Say £9 per full overmark x 40 occasions; partial overmarks x 20 @ £3 each	£420
Herbicides	£100 per application for the whole pitch	£100
Insecticides (Earthworms)	£75 per application for 1/3 of the pitch	£75
Irrigation water supply	If a m^3 (220 gallons) of water costs say, £1.45 for supply and disposal, and if we say the equivalent of 6mm (1/4") is applied over the whole pitch every other week during the period stated in the maintenance calendar, then 36m^3 per week x 10 weeks = 360m^3	£522
		TOTAL £4,738

Bill of Quantities

Guidance figures should be given, although it would be the responsibility of the contractor to ensure they calculate the total materials that they will need to provide to complete the work and achieve the standards.

Item	Proposed Quantity	Contractor's proposed Quantity
Football Pitch	1	
layout Facility	1	
Vertidrain pitch	1	
Application of sand top dressing - 12mm in total	~ 19kg/m^2 (70m x 106 m = 7420m^2) 140 tonnes	
Fertiliser	50g/m^2 7420m^2 371kg	
Grass Seed	50g/m^2 7420m^2 371kg	
Fertiliser	100kg	
Grass Seed	100kg	
Sand Top Soil	40 tonnes	

The contractor will be expected to give a breakdown of the anticipated amounts.

Notes

Technical Terms In Turfculture

acidity	a soil condition where the pH is below 7.0
acitive ingredient	the part of a pesticide from which the efficacy is obtained. The actual toxic material(s) present in a formulation.
adjuvant	a herbicidally inactive material which when added to an herbicide enhances its efficacy.
aeration	operations, which are carried out to improve turf by physical methods to ventilate the soil to improve drainage and to encourage better root development. A process by which air in the soil isreplaced by air from the atmosphere.
aerobic	having gaseous oxygen as part of the environment.
agronomy	the theory, study and practise of field-crop production and soil management – turf culture.
alkalinity	a soil condition where the pH is above 7.0 (alkaline soil).
amelioration	the mixing of a soil ameliorant (or soil amendment) to soil to give it better textural or structural properties and/or drainage.
anaerobic conditions	with little or no oxygen e.g. compacted badly drained soils.
auger	a tool for boring into the soil and withdrawing a small sample for field or laboratory observations.
biological control	controlling a pest by its natural or introduced control enemies.
broadcast application	distribution of material over an entire area e.g. fertiliser or sand.
brush-harrowing	the use of an implement on which brushes are mounted, for the improvement of the surface condition of grass areas.
brushing	the practice of moving a brush against the surface of a turf t lift non-vertical stolons and/or leaves before mowing to produce a uniform surface of erect leaves.
calibrate	measure rate of application of a spreader or sprayer under defined conditions.
capillary action	movement of water between soil particles by virtue of surface tensional forces at the soil/particle interface and between the cells of any organism.
casts	soil and plant remains excreted and deposited by earthworms on the turf surface or in their burrows.
chlorophyll	the green pigment in plants, which is vital for photosynthesis.
clay soil	a soil type containing 40% or more clay-sized particles.

compaction, soil the process in which the soil aggregates and individual soil particles are forced into closer proximity by the application of an external force.

contact herbicide an herbicide that kills weeds by direct contact rather than by translocation.

coring a method of turf cultivation in which soil cores are removed by hollow tines or spoons (see Hollow tining).

cultivar a plant of a single species that differs from another in specific characters such as disease resistance, time of flowering, height of flowering culm, leaf width, and habit of growth. A cultivated variety of a species.

dethatch remove an excessive thatch accumulation either (a) mechanically, as by vertical cutting, or (b) biologically, as by top dressing with suitable soil and aeration.

disease tolerance a species or cultivar showing some degree of tolerance to a disease infection.

divot a piece of turf severed from the soil by a golf club, soccer boot, horse's hoof etc.

dormancy resting stage through which a plant or ripe seeds usually pass and during which nearly all outward signs of life come to an almost complete standstill.

drag brush a wide brush with long still bristles, which is pulled along to work top dressing into flat turf surfaces.

drag mat a flexible steel mat, which is pulled along to work in top dressings, more particularly on undulating turf surfaces.

evapotranspiration water loss caused by the combined effects of direct evaporation from a surface and transpiration by plants.

fertiliser, analysis the percentage by weight of the components found in a fertiliser. For example, a fertiliser with a 14:3:7 analyses contains 14% nitrogen (N), 3% phosphoric acid (P_2O_5) and 7% potash (K_2O). This information must be stated on the package.

fertiliser ratio a ratio of the basic weights of the major nutrients found in a fertiliser. For example, a fertiliser ratio having an analysis of 18-6-6 would have a 3:1:1 ration or 3 parts N to 1 part P_2O_5 and 1part K_2O.

fertiliser any material or mixture which supplies the necessary plant nutrients, usually nitrogen, phosphate and potash.

fibre accumulation of dead plant material in various stages of decay, and living (possibly moribund) stems and root at the turf base. It is usually tough and wiry in texture.

field capacity the percentage of water remaining in a solid two or three days after having been wetted and after free drainage is negligible.

fungi plants lacking chlorophyll that cannot produce their own food, parasitic forms cause turf diseases.

fungicide any chemical which controls or destroys the growth of a fungus.

germination the beginning of visible growth of a plant as it emerges from the seed.

gradient then slope of the ground usually expressed in terms of height increase (or decrease) over a given length eg. 1:200, 11:50.

herbicide a chemical used to destroy or inhibit plant growth.

hollow tining	a form of aeration in which hollow tines (usually cylindrical) are used to remove cores of soil typically 10 mm 3/8 in) id diameter and up to 100mm (4In) deep. Can be carried out with a hand hollow tine fork or using a powered aerator.
infestation	the spread of harmful weeds, diseases or insects in a turf area.
infiltration	the downward entry of water into the soil.
insecticide	any chemical used t kill insects eg. Gamma, HCH.
lapping mower	backward turning of the reel against the soleplate (backlapping) while a fluid dispersed grinding compound is applied.
lawn sand	a mixture of sulphate of ammonia and sulphate of iron mixed together with lime-free sand in the ratio 3:1:20 by weight.
leaching	the removal of materials in solution by the passage of water through sand.
leatherjacket	the larvae (grubs) of the crane fly or daddy longlegs (Tipula species).
lime	an alkaline substance spread on turf to correct acidic conditions. The form most commonly used on turf is ground limestone (containing calcium and sometimes magnesium carbonate).
liquid fertilisation	a method of nutrient application as a solution of dissolved fertiliser.
loam	a soil that contains 7-27% clay, 28-50% silt and more than 52% sand.
lute (loot)	an implement consisting of an angle iron attached to a handle, used to work top dressing into hollows and hollow tine holes.
luting	a method of surface working and levelling for soil, top dressing, compost, sand or like media, by use of a lute.
major nutrients	major plant nutrients are nitrogen, phosphorous, potassium, calcium, sulphur, and magnesium.
marl	calcareous clay.
micronutrient	a chemical element necessary only in extremely small amounts for the growth of plants (usually less than 50 ppm in the plant), eg. boron, chlorine, copper, ironmanganese, molybdenum.
mottie test	a laboratory test of the strength of soil used for the top dressing or construction of cricket pitches. , zinc,
nutrient	any food or material that nourishes or promotes plant growth.
outfall	the outlet of a drain eg. into a ditch.
over-sowing (over-seeding)	seeding the repair of thin areas of sward by lightly cultivating the surface and sowing additional seed.
pan	a term given to a soil layer that is appreciably more compact and less permeable than the layers above or below it.
parasite	an organism that takes its food from the living tissues of a host organism, causing some damage to the hose.
perennial	a plant that requires more than two years to complete its life cycle.
persistence	the ability of a species or cultivar to survive, especially under heavy wear conditions.
persistent	used to describe a pesticide that remains in the environment for a long time.

pesticide	any substance or mixture of substances intended for preventing or controlling any unwanted species o f plants and animals and includes any substances intended for use as a plant growth regulator, defoliant or desiccant. Would include fungicides, herbicides and nematicides. As per FEPA 1985, “any substance, preparation or organism prepared or used for destroying any pest.”
photosynthesis	the process by which plants containing chlorophyll convert sunlight, carbon dioxide and water into organic compounds eg. sugars, for their own use.
poa annua	annual meadow grass. A common weed grass of turf.
pore space	the total space not occupied by soil particles in a volume of soil.
pre-germination	preconditioning of the seed prior to planting by placing it in a moist, oxygenated environment at optimum temperature to favour more rapid germination after seeding.
primary shoot	the simple shoot stage in the development of a seedling.
rate of seeding	the seed rate used eg. grams per square metre or kilograms per hectare.
release rate, fertiliser	that rate of nutrient release following fertiliser application. Water-soluble fertilisers are termed quick release, while insoluble or coated soluble fertilisers are referred to as slow release.
renovate	to rebuild a turf using an existing turf as the seedbed ie. surface cultivation and reseeding a badly worn soccer goalmouth.
ribbing	closely spaced lines of longer grass at right angles by the direction of mowing. Usually caused by mowing with a cylinder mower when the grass is too long or with a badly adjusted or damaged machine.
root system	the underground downward growth of a plant; anchors plant to the soil and absorbs moisture and nutrients from the soil for use by the entire plant.
rootzone	the layer of growing medium in which the majority of plant roots are found. (When applied to ameliorated soils or soil mixes the rootzone is defined by the layer thickness at construction rather than by the amount of roots present at any depth).
scalp	to cut the turf from the soil, or to mow extremely close, or to cut into the grass crowns.
scarification	a cultural operation carried out by means of a rake, or a mechanically operated implement to produce a healthy vertical type of growth of the desirable grasses. The process brings up flat growth of the grass so it may be mown off, so giving the turf a ‘clean look’.
scorch	browning of turf caused by mis-application of fertiliser or pesticide, spill of hydraulic oil, etc.
seed mixture	a mixture in various proportions, of seed of different species or cultivars. The inclusion and the proportions of species and cultivars in the mixture depend on the use to which the turf will be put in the future.
selective herbicide	a weed killer capable of controlling one type of weed without damaging other types of more desirable plants.
sharps	a general term referring to any sharp object encountered in the workplace, particularly items such as broken glass or nails in wood. The term also refers to hypodermic needles.

shear strength	the resistance of the surface layer to horizontal motion through it. This property governs the degree of traction or grip obtained by a player wearing studded or spiked footwear.
shoot density	the number of shooter per unit area.
slitting	a method of turf cultivation in which vertically rotating, flat blades slice intermittently through the turf and the soil. Also called slicing or slit tining.
slow-release fertiliser	designates f fertiliser with a rate of dissolution less than that of completely water-soluble fertilisers; may involve compounds, which dissolve slowly, materials that must be decomposed by microbial activity, or soluble compounds coated with substances highly impermeable to water. ‘Slow release’ used interchangeably with ‘delayed release’, ‘controlled release’, ‘controlled availability’, ‘slow acting’ and ‘method release’, eg. IBDU.
soil acidity	the degree of acidity or alkalinity of a soil. The soil reaction (the degree of acidity or alkalinity in terms of hydrogen ion concentration) is presented on the pH scale ranging from 0, very highly acid to 14, very highly alkaline. Most soils in Britain range from pH 4.0 to pH 8.0.
soil fertility	this refers not only to the plant food status or the soil but also aeration , moisture supply, organic matter content and acidity of the soil.
soil organic matter	the organic fraction of the soil, which includes plant and animal residues at carious stages of decomposition, tissues of toil organisms and other products formed by the soil population.
soil organisms	these range greatly in size and include moles, earthworms, protozoa, fungi and bacteria. Living organisms are very important in the breakdown of organic matter in the soil.
soil profile	a vertical section of the soil through all its horizons. Such a profile will show the depth of tap and subsoil, degree of compaction etc.
soil structure	the manner in which primary soil particles (ie. sand, silt and clay) are grouped into aggregates. The binding together of particles is brought about by complex interactions between soil particles, organic matter and various chemicals in the soil.
soil tests	laboratory tests to determine eg.. the pH (acidity or alkalinity) and nutrient status of a soil.
soil texture	soils are classified into their various textural classes such as sandy loams, loams or clays by their percentage of clay, silt and sand. The texture of the soil maybe determined in a laboratory test or by smearing he soil in the hand and adjudging its stickiness or grittiness.
spiking	a method of turf cultivation in which solid times or flat pointed blades penetrate the turf and soil surface.
stress	a condition under which a plant suffers due to lack of moisture, nutrients, extreme heat or any combination of the three.
sub-aeration	where excessive compaction exists in a soil this can be relieved without causing severe surface disruption by sub-aeration using a mini mole plough or either the rigid or vibrating type.
sulphate of iron	the iron sulphate, a chemical used to kill moss and algae and to ‘green up’ turf.
summer of dormancy	the cessation of growth and subsequent death of leaves of perennial plants due to heat and/or moisture stress.

surface heave	the production of an uneven playing surface by soil being forced upwards or during drainage work, sub-soiling or sub-aeration etc.
surfactant	a material that improves the emulsifying, spreading, wetting and other surface modifying properties of chemical formulations.
sward	the above and belowground parts of a population of herbaceous plants (usually grass) characterised by a relatively short habit of growth and relatively continuous ground cover.
switching	using a bamboo or fibreglass switch to remove dew and exudates from turf by moving the switch in an arc while in contact with the turf surface. Also used to break up earthworm casts and clumps of clippings.
thatch	a layer of intermingled dead and living shoots, stems and roots that develops between the zone of green vegetation and the soil surface.
thatch control	prevention of excessive thatch accumulation by cultural manipulation and/or reduction of excess thatch by mechanical or biological means.
thatch fungi	a group of basidomycete fungi, which feed upon excessive thatch in fine turf, producing localised patches or rings, which destroy that playing surface. Sometimes called superficial fairy rings.
tilth	the state of the upper layers of the soil, in respect of size of aggregations, resulting from cultivation and/or weathering.
tolerance	degree to which a plant endures a stress.
top dressing	bulky material added to turf to improve the surface layers. It is usually physically worked in by matting, raking or brushing and often contains sand, compost and organic matter.
topsoil	the upper layer of soil usually containing organic matte and living material.
total weed killer	herbicide used to kill all existing vegetation and to keep a clean weed-free surface, eg. on footpaths, car parks or hard tennis courts.
transpiration	the transfer of water vapour from the plant to the atmosphere.
turf cutter	a machine used to cut turf (sods) for future transportation and relaying.
turfgrass culture	the composite cultural practices involved in growing turfgrasses for purposes such as lawns, greens, sports facilities and roadsides ie. non-agricultural use.
urea	a water-soluble nitrogen compound, used in fertiliser, made from carbon dioxide and ammonia.
ureaform	a slow release fertiliser providing gradual release of nitrogen over a period of time.
vertical cutting (mowing)	involves a mechanical device having vertically rotating blades that cut into the face of a turf for the purpose of controlling thatch or grain. verti-drain a tractor drawn machine, which can break up compaction by means of tines and provide cracks and fissures along which water movement and root growth can take place.
water table	the upper surface of ground water or that level in the ground where water is at atmospheric pressure.

water table (perched or suspended)	the water table of a saturated layer of soil or sand, which is separated from an underlying, saturated layer by an unsaturated layer. In sports turf construction, gravel carpets are sometimes used to create a suspended water table, which increases moisture retention in the rootzone.
wear resistance	the resistance of the turf to wear. Good drainage, correct fertiliser use and the choice of a wear resistant species or cultivar of turfgrass can achieve this.
wet wilt	wilting of turf in the presence of free soil water when evapotranspiration exceeds water uptake by the roots. The inability of a plant to absorb enough moisture through the roots to equal the rapid loss of moisture through the leaves.
wetting agent	a chemical that improves the wetting properties of a solution. (see also surfactant).
winter fertilisation	a late autumn to winter application of fertiliser to turfgrasses at rates that maintain green colour without causing adverse physiological effects; used in regions characterised b moderate winters for the species involved.

Notes