The Agricultural Engineer

Incorporating Soil and water

Volume 48 Number 2 Summer 1993

Developments in grass cutting

AE 48 (2)

Institution of Agricultural Engineers
Forestry Engineering Specialist Group

Low cost unsurfaced roads

Nine speakers with a cumulative knowledge totalling 200 years will instruct on every aspect of constructing unsurfaced lorry roads in Britain. The speakers will come almost exclusively from the Forestry Commission therefore the emphasis will be on low cost, good value and difficult conditions.

See inside back cover for details.

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Volume 48 No.2, Summer 1993

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Front cover: Newcastle University's prototype mower, developed with the help of funding from the Douglas Bomford Trust. More details page 38.

Regular Features

Journal and Proceedings

CONTENTS

COMMENT

Barry Sheppard

Change of editor

Allan Langley

The Scottish Branch is providing yet again the Honorary Editor for the Journal. As from this issue, Allan Langley, also of SCAE and Scottish Branch, is taking over from Barry Sheppard and, as members will remember, before Barry there was Jim Pascal, who succeeded Brian Witney, who succeeded Hamish Shiach. A goodly record!

In Barry's three years as Hon Editor he has also been a member of the Working Group carrying out overall review of the Institution's publications. We now have the closer involvement of the Newsletter team with the Journal and the incorporation of some former Newsletter items – hopefully making the journal yet more reader-friendly. The Legal page introduced by Barry has been well received and Barry has worked hard to get more news of Branch and Specialist Group papers.

Barry has also been active for many years in the highly successful Forestry Engineering Specialist Group – as founder committee member and Hon Treasurer.

Allan Langley is also no stranger to Institution office. Five years as Conference Convenor for the Scottish Branch has given him an in-depth understanding of members' interests.

All members will want to thank Barry for advancing the high standard of the Journal, to wish him well for the future and to offer Allan full support, as our new Honorary Editor.

Geoff Baldwin, Production Editor

ISSN 0308-5732

The Institution of Agricultural Engineers

Cabot Safety extends range of respiratory products

Designed to protect the wearer against most industrial respiratory hazards, the 7-Star Full Face Mask Respirator is fitted with a central, European standard, 70mm female thread to accept a wide range of filter canisters, including any of Cabot Safety's new Multi Star range. Clean air enters through the filter and passes over the inside of the visor, which has been carefully engineered to prevent misting; the air is then drawn into the wearer's lungs via non-return inhale valves in the inner mask, and finally expelled through a single non-return valve in the front of the mask.

An addional benefit to the wearer is the ability to communicate effectively through the inclusion of a high efficiency speech diaphragm.

Further details from: Cabot Safety Limited, First Avenue, Poynton, Stockport, Cheshire SK12 1FJ. Tel. 0625 878320.

RESEARCH NEWS

It is proposed, in the future, to include in the News and Views section, reports on research activities at organisations in the UK. If any member would be interested in providing a brief report, 100 to 150 words, on their current research activities would they please forward information to: Denis Cartmel, Grisedale, Stafford Road, Penkridge, Stafford ST19 5AX. Tel. 0785 712690.

Perkins 'green' diesel powers Volvo loader

The power behind the Volvo BM L50B shared loader is Perkins' latest low emissions 1,000 Series engine.

UK Agricultural Engineering Trade 1992

The total value of exports of agricultural engineering products rose by 1.2% in 1992 to £775.1 million. Within this total, exports of agricultural machinery fell 5.3% to £217.6 million but exports of tractors rose 3.3% to £514.5 million. Total imports rose 6.3% to £453.3 million leaving an overall positive trade balance at £321.8 million.

Export/import	*1991 £m*	*1992 £m*	*% change*
Exports			
Agricultural Machinery	229.7	217.6	–5.3
Tractors	497.9	514.5	3.3
Tractor Engines	38.0	43.1	13.3
Total	765.6	775.1	1.2
Imports			
Agricultural Machinery	283.9	311.8	9.8
Tractors	118.7	118.9	0.2
Tractor Engines	23.9	22.6	–5.3
Total	426.5	453.3	6.3
Balance of trade	339.1	321.8	–5.1

Source: AEA

The EC provided a poor market in 1992 with exports falling much in line with overall market conditions but exports of tractors proved remarkably strong with an overall increase of 34%. The USA proved to be a weak market in 1992 despite a reasonable underlying farming situation and exports of both machines and tractors fell back.

Market	*1992*		*% of total exports*
	£ '000	*% change*	
Agricultural machinery			
1. France	32,114	6.9	14.8
2. Irish Republic	29,502	5.8	13.6
3. USA	23,097	–8.3	10.6
4. Germany	21,357	–42.7	9.8
5. Netherlands	14,017	–0.6	6.4
EC total	126,776	–9.9	58.3
World total	217,593	–5.3	100.0
Tractors			
1. USA	97,515	–21.6	19.0
2. France	44,758	34.4	8.7
3. Germany	32,302	47.9	6.3
4. Netherlands	27,065	52.9	5.3
5. Belgium/Luxembourg*	21,892	183.4	4.3
EC total	191,604	34.2	37.2
World total	514,458	3.3	100.0

*under investigation

Source: AEA

Water windmills

Galvanised steel windmills manufactured by a specialist company provide an ideal means of obtaining a water supply for farms, estates and plantations. They are also widely used for irrigation and drainage work, according to Mr Basil Crowther, proprietor of Mid Wales Welded Productions of Llanidloes, Powys.

The windmills cost an average of £5,000 and the towers are 20ft to 60ft high, with wheels from 6ft to 18ft in diameter and between 18 and 24 sails.

They can draw water from a maximum depth of 400ft and are capable of extracting up to 6,800 gallons of water an hour, explained Mr Crowther, who advises on the depth and positioning of boreholes.

Maintenance and running costs are minimal, with only a gallon of oil in the gearbox needing changing each year. By comparison, the Severn Trent Water Authority charges £288.18 for the supply of 1,000 metered gallons of water.

Two of Mr Crowther's windmills have been successfully put to use in West Indian villages where they provide drinking water for the local population. Closer to home, in the Clent Hills, a Crowther windmill sits atop a 5ft diameter 140ft deep well, to irrigate hills wooded with around 16,000 oaks.

Further information from:– Mr Basil Crowther. Tel: 05512 2104.

The Water Windmill on site in the Clent Hills.

First radial Terra-Tire

The world's first public display of a high-tech radial 'Terra-Tire' – an exclusive Goodyear low pressure farm tyre, was made at the SIMA agricultural show in Paris.

Goodyear's Director, Sales and Marketing, Farm Tyres for Europe, Mr Robin McKnight, said: "This radial construction Terra-Tire recognises the need for tyres to match the ever increasing performance demands of today's high horsepower tractors and their accompanying more heavily laden machinery and equipment. The radial Terra-Tire will offer the farmer its already proven performance in respect of minimising soil-compaction and at the same time provide greatly improved over-the-road performance characteristics. We will be continuing bias production for some time to come but expect the radials – as we develop more sizes – to be a very popular addition to our range."

Goodyear Gt Britain Ltd, Stafford Road, Wolverhampton WV10 6DH. 0902 22321.

Electric power in remote areas

Truly lightweight portable generators may become available as a result of revolutionary work undertaken by Mohammed "Shahram" Etemad of Imperial College, London. His high speed electric generator coupled directly to a gas turbine engine is a major improvement on conventional systems. It could lead to 50kW high speed generators being used in remote areas all over the world.

Air conditioning system for agricultural vehicles

Diavia UK has been commissioned by specialist agricultural vehicle manufacturer, Lucassen Young Ltd of Carlton, Stockton on Tees, to design and install a total air condioning system for its latest product range, the Clayton 4105 lightweight tractor.

The air conditioning system designed by Diavia was installed into the prototype 4105 during the spring of 1992. Trials proved extremely successful and Lucassen Young Ltd has now commissioned air conditioning systems to be supplied in kit form from Diavia for installation into its first production vehicles.

A cab installed with air conditioning eliminates most pollutants through its filtration system (carbon filters are available as an option), before they reach the interior of the cab. The operator can select the temperature and humidity level desired through easy to operate controls creating his own optimum working environment.

An additional feature important particularly during inclement weather conditions is that the air conditioning demists all windows virtually instantly, providing exceptional visibility.

"Since the vehicle's launch during October 1992, we have received a considerable amount of orders – all specifying the air conditioning option," commented Eric Clayton, Director of Lucassen Young Ltd.

Further information from: Diavia UK, Daneshill Industrial Park, Basingstoke, Hants RG24 0NS. Tel: 0256 842111.

The Clayton 4105 lightweight tractor featuring an air conditioning system designed by Diavia UK.

High capacity single-axle weighbridge

A new single-axle weighbridge of low profile design provides easy installation in a shallow pit. It has no moving parts, with precision shear beam load cells supporting each corner of the weighbridge, alleviating the need for the tie-bars of conventional weighbridge construction.

One of the main features of the Griffith Elder weighbridge is that it uses stainless steel load cells which are fully welded and sealed to IP67. This makes them virtually trouble-free even in the most hazardous conditions.

Dynamic (in-motion) weighing is the principal feature of the single-axle weighbridge, enabling the vehicle to be weighed without stopping.

Simple to operate, the standard unit incorporates a tally roll printer providing a hard copy of individual axle and total vehicle weight for each weighing. The single-axle weighbridge is easily transported to be used at different prepared sites and meets a wide variety of vehicle applications on the farm.

Griffith Elder & Co Ltd, 2A Cavendish Road, Bury St Edmunds, Suffolk IP33 3TE (Tel. 0284 763616).

The French Connection

Rycotewood College Engineering Department is celebrating the success of their first venture into student exchanges between twelve of their second-year HND (Agricultural & Construction Plant Engineering) students and a similar number from the Lycee Georges Cornier, Coulommier, about 60km east of Paris.

What makes this a little different from the norm is that the students are on work experience placements at the time. Rycotewood's students spent two weeks in France during April, working alongside their contemporaries. The French students then accompanied the returning group to spend a couple of weeks experiencing life in an English workshop. The success of such a venture hinges on the co-operation of the companies providing the work experience, and it is to the credit of the following local employers that they were prepared to get involved: AWS; Kubota (UK) Ltd; Farol Ltd; Helpful Hirings; Risborough Turf; and Oxfordshire County Council.

Top quality training

Pershore College of Horticulture recently achieved the distinction of BS5750 accreditation for the management of its education and training functions. **David Hinchcliffe** AMIAgrE has been instrumental in co-ordinating the review of the College's management proeedurcs, an involved and arduous task requiring elosc examination of every facet of the teaching and training within the college.

The systems employed were audited hy SGS Yarsley, an external accrediting agency. To ensure continued compliance SGS Yarsley will revisit the college at six-monthly intervals.

David, and his Principal Dr David Hall, were naturally delighted with their team's success. The next step is to gain recognition of quality management of the staff by achieving the Investors in People Award. Well done, David, Dr Hall and Pershore College, may your achievements bring you good fortune!

Rotary torque transducer

Traditionally rotary torque is difficult and expensive to measure, but for the first time, by using existing technology in a novel way, inexpensive transducers suitable for OEM use can be produced for situations where critical torque monitoring of control or drive mechanisms is required.

Sensor Technology is developing a range of low-cost transducers for applications with outputs suitable for interface with computers and PCs as well as more conventional analogue and digital readouts. These transducers will require minimnm lengths of shaft and will have low inertia, no physical contact between shaft and housing, wide bandwidth, high resolution and accuracy, and excellent noise immunity. The system is also suitable for attachment to existing shafts.

Enquiries: Tel. and Fax. 0295 730746.

GKN Comaxle agreement with Massey Ferguson

GKN Comaxle, a subsidiary of the world-wide GKN Group, has announced a long term trading agreement with Massey Ferguson to supply front steer drive axles to MF plants in Coventry, UK and Beauvais, France. The agreement means that GKN Comaxle will continue to supply 100% of MF 4-wheel drive agricultural steer drive axles. All axles will be supplied from GKN Comaxles' plant in Como, Northern Italy.

Under this Act. for instance, it would be illegal to force a worker with a respiratory condition to work in a very smoky atmosphere. Recent civil cases have also highlighted potential liability in this area.

AGM Service, March 1993

Massey Ferguson notches 30th successive year

Massey Ferguson tractors remained the best-selling make in western world markets in 1992 for the 30th consecutive year. The preliminary figures for last year show the company maintained its leadership with MF tractor sales outstripping their nearest rival by more than 40 per cent. While total industry sales of tractors in the world outside the former USSR and Eastern European territories fell about 2.5 per cent from 1991 levels to approximately 536,000 units, MF succeeded in offsetting the decline, increasing its own sales to approximately 99.000 units, over 6,000 more than in 1991.

Optical digital tachometer

The new DT-2244 from Graham & White Instruments Ltd. St Albans (Tel. 0727 59373) is a hand-held portable Optical Tachometer with a full 5-digit liquid crystal display (LCD). This enables the user to measure rotational speeds in direct sunlight as well as in covered areas.

Reflected light pulses from a strip of suitable tape on the target surface are converted using an exclusive microcontroller LSI chip circuit, and displayed as a numerical reading. The speed range is from 5 to 99,999 rpm with accuracy down to ± 1 rpm. After measurement, a memory recall is available for the last reading. An optional remote plug-in optical probe with 5m cable is available for difficult to reach targets.

Management buyouts

Spalding Agricultural Holdings today announced a management buy-out of four agricultural businesses in the UK, France and Ireland from their parent company Haden MacLellan Holdings plc. The buyout was led by Alan Trafford, the Chief Executive of Spaldings, supported by six of his management colleagues from both the UK and France.

The group employs approximately 200 people and has a turnover of almost £20,000,000. Spaldings, together with the French and Irish subsidiaries, is the largest independent agricultural replacement parts distributor in Europe. Further European expansion of the business from the successful base in France is envisaged in the near future.

Alan Trafford.

Also, the management of Welvent Ltd of Tritton Road, Lincoln have announced a buyout from parent company Spaldings.

Welvent are well known for their range of Crop Storage Equipment, and claim to be market leaders in the supply of Drive-on Drying Floors, and associated equipment. They manufacture and supply a variety of Potato Storage Equipment including Refrigeration and Microprocessor Controls.

Grantsource

The Corporate Development Centre (CDC) has introduced Grantsource, a grant location research service. With experienced researchers monitoring and updating a database of over 1,000 schemes CDC can provide accurate and up to date information on investment grants which are available to an organisation.

Further details: Mr C Sayers, 98 Nelson Road, Leighton Buzzard, Bedfordshire LU7 8EG. Tel. 0442 213199. Fax 0442 234766.

Advising Silsoe Link

Silsoe Link, the collaborative agreement between Silsoe Research Institute, Silsoe College, ADAS and the Soil Survey and Land Research Centre, have recently put together their mission statement. It states: "The aim of the Silsoe Link partners is to develop, disseminate and apply scientific, engineering and management knowledge relating to the sustainable and efficient use of natural resources (land, soil, water, flora, fauna) for the benefit of mankind both nationally and internationally".

To assist the Silsoe Link Executive Committee an Advisory Committee has been formed to ensure that the aim of the mission statement remains true and to provide advice to improve the usefulness of the partnership to its members. John Hall, lately our News of Members correspondent, is to Chair the Advisory Committee. The Committee comprises: Dr Breach (Severn Trent Water Authority); Geoff Burgess CIAgrE (Parmiter Ltd); Richard Dicks (Farmer); Dr Mike Dwyer FIAgrE (MAFF); Bill Pickup (Farmer); Michael Williams (Journalist). Edwina Holden is the Secretary.

Service vehicle storage system for efficiency and image enhancement

The ESTOR storage and organisation system can be used in virtually any estate car currently available and in many popular hatchbacks, say manufacturers, Bott Ltd of Bude, Cornwall (tel. 0288 355666). The standard kit includes:

- profiled plywood floor with integral locator channels – protects carpets: no need for any floor or body drilling;
- metal three rack unit;
- two metal service cases located on rattle-proof brackets;
- row of three lock-together polypropylene containers.

The entire ESTOR unit, including its contents, can be removed from the vehicle in less than two minutes and re-installation is said to be equally rapid. Price: £299 incl VAT.

Developments in cutting of grass

Tom Copland describes the history of, and the background to development work in, rotary shear cutting of grass. With the objectives of achieving improved performance combined with reduced power demand, a project was set up at Newcastle University to combine the main advantageous features of both the rotary mower and the finger bar mowers. A prototype mower was developed and shown at the 1987 UKF Grassland Demonstration at NAC, Stoneleigh. Field test results of the prototype mower are presented.

The original concept of using rotary cutting goes back to a UK mower patent of 1799 granted to Joseph Boyce. The patent describes a mechanical reaping machine with scythe blades. The shortcomings of this early mower led Thomas James Plucknett, an implement maker, to use 'a circular steel plate made sharp at the edge and notched at the upper side like a sickle'. The Gladstones Rotary Shear Mower (Fig 2b) used fixed fingers above the rotating knife and by 1811 a successful design had been evolved (Fussell 1985).

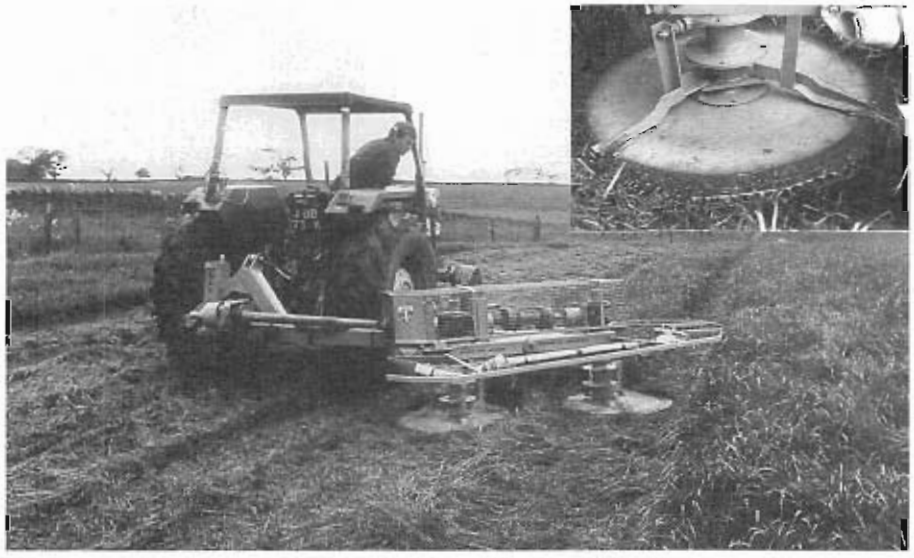


Fig 1. Prototype mower (inset: one of the rotating disc assemblies).

Finger bar mowers for animal draft

In 1831, Rev Patrick Bell's reaping machine (Fig 2a) was described by J. C. Louden in *Encyclopedia of Agriculture*. Many of the features show that this mower was the precursor of modern finger bar mowers (Fussell 1985).

Finger bar mowers provide the best meehanism for animal drawn use and dominated mowing until the early 1960s. These machines cut in shear with knife sections riveted to the rigid knife back that moves back and forth supported on fingers. The knife sections are riveted to allow replacement when either damaged or worn.

Although the traditional finger bar mower is energy efficient the speed of the reversal of the knife limits performance. At mid-travel the knife speed can reach or exceed 6 m/s before being stopped in register with the centre of a finger at the limit of the knife's outer and inner stroke. At high forward speed large variations in grass stubble height are seen.

Drum and disc mowers for high speed work

The drum and disc mower common today is capable of high forward speeds in a wide variety of crops. Cutting is by impact rather than by shear and more power is required for this process.

Cutting plant material – the principles involved

Many of the principles involved in mowing equipment have been understood by practitioners for a very long time. Quantitative data for engineering design have been more difficult to obtain on account of the variability of grass during its various stages of growth, the daily change in moisture content, the geometry of the knife and support system (ledger), and the speed and direction of knife motion.

Cross cutting of fibrous material involves compressing the fibres until the shear strength of the material is mobilized to produce tensile stresses large enough to break the fibres in tension.

The compressive forces required to produce these high stresses are such that the material is noticeably compressed and flattened before the fibres fail.

The cutting can be viewed as a multi-stage process: the knife first contacts the material, the forces increase as a stress pattern is built up inside the material, and then failure is reached. In thick layers separation is achieved in a series of ruptures.

Grass may be assumed to be a solid material with liquid and air filled spaces in the fibre cells (Persson, 1987).

Individual cell diameters vary within a range from 5 to 50μm with typical grass cell lengths of around 30mm. The cell wall is very thin, typically in the order of 500nm made up of three layers. Strength and flexibility comes from the middle layer where parallel cellulose chains are bound spirally up the cell wall. These spirals give the cell its elasticity. The fibrous material forming the walls has high tensile strength while the bonding of these fibres has comparatively low strength.

These cells are arranged in structural elements of 0.1 to 0.2mm diameter known as vascular bundles. In young grass they are located within the tissue mass while in older grass the vascular bundles are distributed towards the outside of the stalks.

Knife geometry

A knife with a sharp edge (small edge radius) will create the necessary failure condition with a smaller edge force.

Tom Copland is Head of Mechanisation at the Scottish Centre of Agricultural Engineering, SAC, Bush Estate, Penicuik, Midlothian EH26 0PH.

Paper presented at the Scottish Branch Conference, 'Amenity Grass', Perth, 24 February 1993.

Engineering for th

The Scottish Branch An

Amenity

Engineering for the amenity sector is an area we have previously neglected in the Institution. It is, however, one of the few areas of expansion in our industry and of growing importance. It was with this in mind that the Scottish Branch decided to feature amenity grass at its annual conference earlier this year.

One of the main objectives of this conference was to help our members to achieve an improved understanding of the needs of those in the amenity grass business.

Amenity Sector

ıal Conference 1993

Grass

Perhaps equally important it also enabled the people in this sector to become acquainted with our Institution and learn about some of the latest developments in the field of engineering for amenity grassland.

Over 60 people attended the conference and many of those attending, such as those from the local authorities and machinery dealers were previously unaware of our members' involvement in this sector.

Roger Hay – Chairman of Conference

Fig 3 (Chancellor, 1958) shows that below an edge thickness of 0.15mm there is no further reduction in force. In practice, the strength of the crystal lattice in the blade material will limit the blade sharpness. A very sharp edge will quickly dull until the distributed forces on the edge may be supported. Impurities (particularly silicon) in the grass have an adverse effect on sharpness.

Knife sharpening angle and edge radius are related – a small knife angle is needed to reduce the wedging forees when cutting thick materials. Fig 4 (Chancellor, 1958) shows that 30° is a practical compromise as there is not much advantage in smaller angles. The blade sharpness at small angles is short lived as there is less material to support the edge.

In tests conducted by Chancellor (1958) at cutting speeds common in mowers, knife clearance was shown to have no significant effect on the maximum cutting force within the range 0.13 to 0.64mm

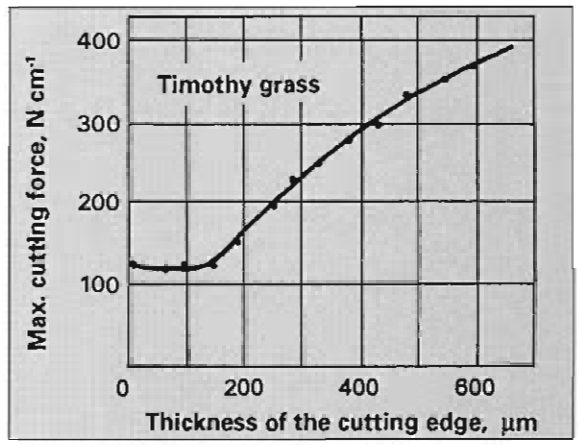


Fig 3. Effect of cutting edge thickness on cutting force.

when the knives are sharp. Below this, friction starts to play a part.

Typical mowers working in the field will have blunt blades and shear bars where the clearance may be more important. Excess clearance leads to tearing and 'hair pinning'. Hair pinning describes the situation where grass does not break but wraps itself around the cutting edge with the result that clearance is often increased.

To cut cleanly it is important that the reaction force is as close as possible to the line of the cutting force to prevent bending moments developing in the stalks.

The ledger should have a sharp edge with a small edge radius but may have a large edge angle. In most cases this support (ledger plate/finger/shear bar) should not penetrate the material being cut as to do so increases power. The edge on a shear bar is often self-sharpening as it is made with hard surfacing on the faee across which the knife sweeps.

Fig 5 shows a blade moving normal to its direction of travel (arrow N) contacts some grass, the grass is bent around an edge of radius 'r' with an angle of ABC. However if the blade lies at some angle to its direction of travel (arrow S) then the grass is bent round an edge of radius 'q' with an angle of ADC. This smaller edge radius increases the stress in the material reducing cutting forces. The slicing cut uses this concept to advantage. Kepner

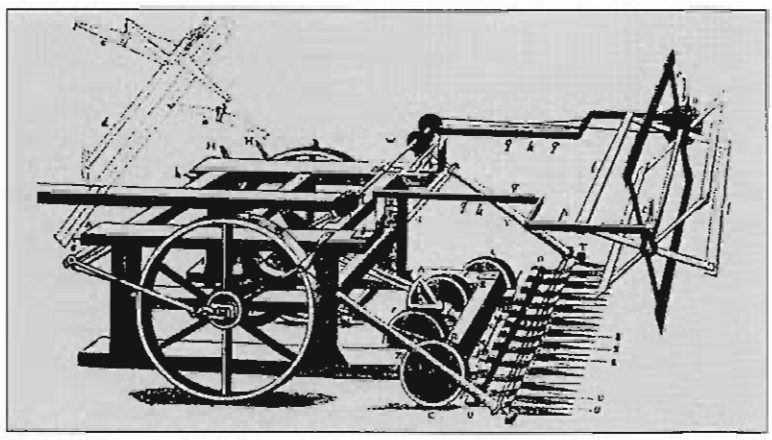
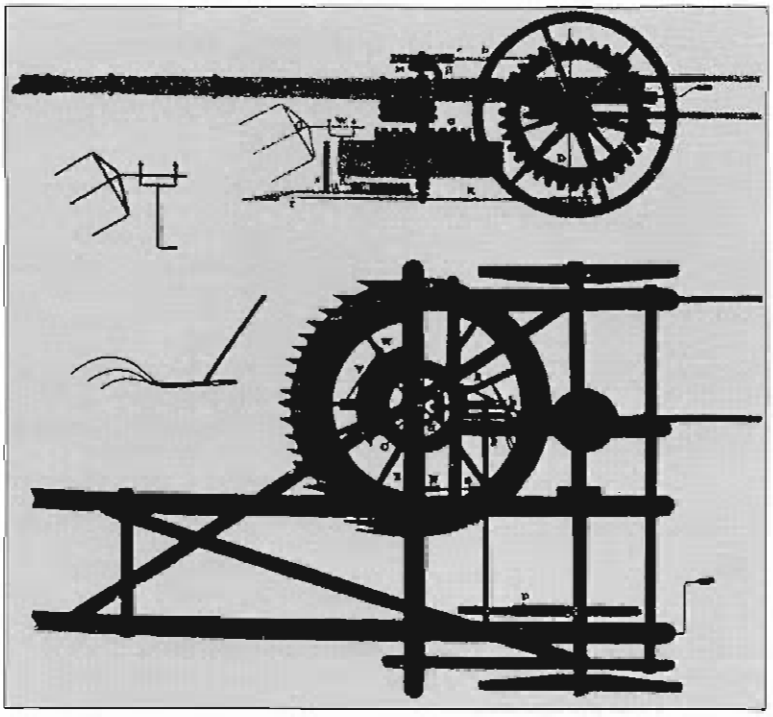


Fig 2a (above). Bell's Reaping Machine; 2b (below): Gladstones' Reaping Machine. From: G E Fussell, 'The Farmer's Tools', 1985.



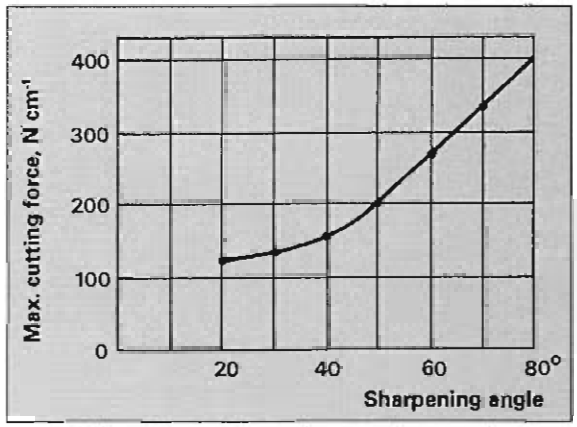


Fig 4. Effect of sharpening angle on maximum cutting force.

(1952) showed that on a shear cutting mower the angle between the blades is limited to twice the angle of friction between steel and grass, typically 40°.

Reducing energy use

The factors discussed above all affect the performance of shear cutting mowers and any new development must conform to these requirements.

A development project was set up to combine the main advantageous features of both the rotary mower and the finger bar mowers. Reducing energy use was the main objective. The

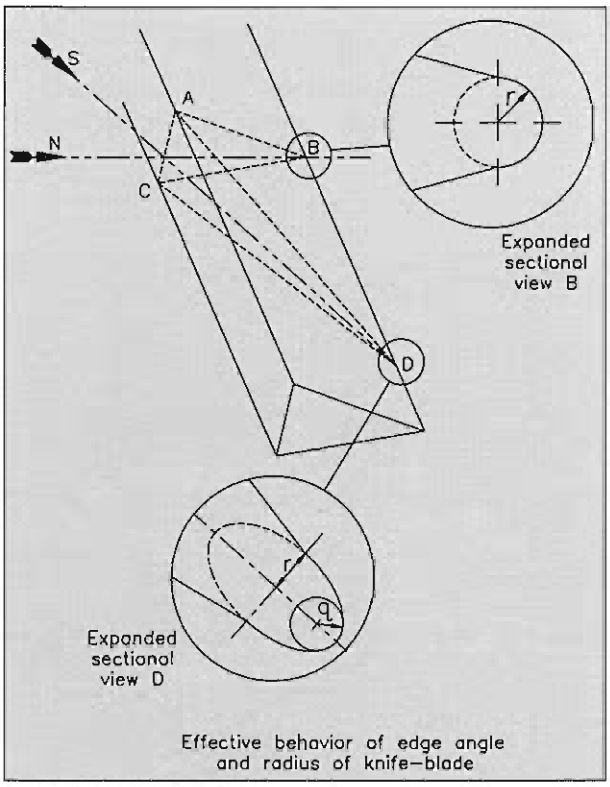


Fig 5. The slicing cut.

design and modelling of the prototype was undertaken by Mike Watchorn as part of an MPhil degree at the University of Newcastle upon Tyne. Mike Watchorn was the 1986 Douglas Bomford Scholar and the assistance of the Douglas Bomford Trust is acknowledged.

The specification for the prototype was to demonstrate that a farm scale machine of two metre cut could be built to give rotary shear cutting on two discs.

The prototype mower is shown in Fig 1. There are two rotating assemblies each with counter rotating discs carrying cutting elements. The top disc in each assembly rotates to carry the cut grass through the centre of the mower to leave a controlled swath behind.

Early field rig testing by Watchorn (1986) and Sewell (1986) demonstrated that one metre diameter discs turned from 6 and 10 mm steel plate were sufficiently flat to keep blade geometry correct.

Minimum edge radius and low knife angles with minimum clearance were the key elements of the design brief. Knives were fitted to the bottom disc and ledgers to the top disc to minimise the stubble height. The blades and ledgers ran in contact with one another which self-sharpened the knives.

A shallow angle between the knives and ledgers gave a small clearance at the blade root.

The counter rotating discs were made of glass reinforced plastic (GRP) to allow compliance with manufacturing and running misalignments. Controlled pressure was maintained between the two discs by preloading during build and by adjustable spring loaded lever arms. The maintenance of this pressure controlled hair pinning.

The prototype was designed to give blade tip speeds of between 3.5 and 9.5 m/s.

Mathematical model of performance

Watchorn (1987) developed a mathematical model to predict mower cutting quality. This computer model predicted the blade position and motion and the grass cut by the intersection/meshing. The model calculated the stubble height at discrete intervals.

The computer output for one blade run is shown in Fig 6. Each trapezoid is the mesh of one top ledger with a consecutive series of bottom blades. (Note that the stubble error on the right hand side of the figure is greater at the bottom, the centre of the two-drum mower.)

The example is for an 18 ledger top disc and 35 knife blade bottom disc at 7 km/h forward speed and 9.5m/s cutting velocity. 9.5m/s was obtained at disc rotational speeds of 180 rev/min.

These small trapezoidal areas lead to variation in stubble height due to bending of the stalks. Stubble height uniformity improved with higher rotational speeds but got poorer with increased forward speed. The model allowed the effect of blade numbers versus rotational speeds to be studied.

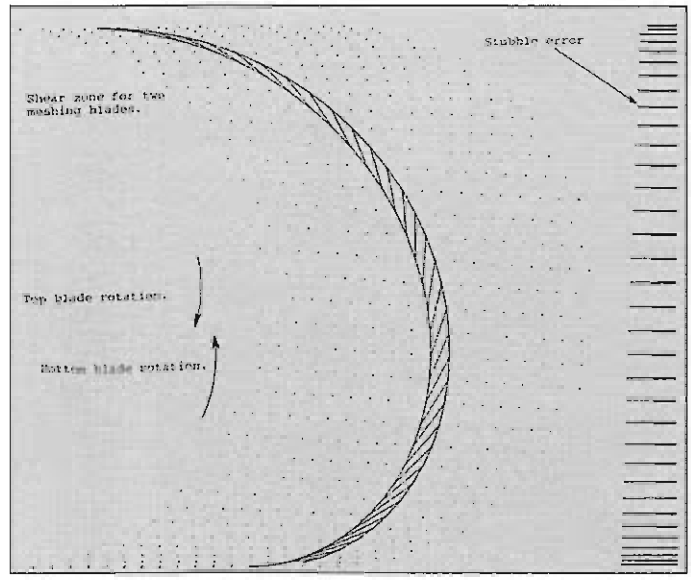


Fig 6. Example of the output from the model.

Practical results

The model was verified in field tests with 36 ledgers on the top disc and 35 knife blades on the bottom disc. The final ledger:blade number ratio selected was 96:35 giving a theoretical variation in stubble height of 0–25mm.

In practice, the stubble variation is difficult and time-consuming to measure as there is variation along the path of the mower. Actual results of stubble height measurements taken across the full two metre width of the mower with 96 ledgers and 35 blades are shown in Fig 7. The problems of long stubbles occurred in the middle of the two metre swath as predicted by the model. The stubble height uniformity improved with crop yield.

Power measurements shown in Fig 8 were taken during the field test programme and show a wide range of results. There is no correlation between crop yield and power, probably due to the crude nature of the drive train constructed from salvaged 'Rotavator' gears. These results contrast with 13 and 15 kW/m for a normal disc and drum mower respectively reported by Tuck *et al* (1979).

The two metre prototype mower demonstrated the potential of rotary shear cutting but if a fine uniform finish is required then the ratio of cutting speed to forward speed must be high. The forward speed used during testing was as high as 14 km/h.

Matching the diameters of the upper and lower disc blade tips is the key aspect of fitting as one millimetre mismatch can lead to poor cutting.

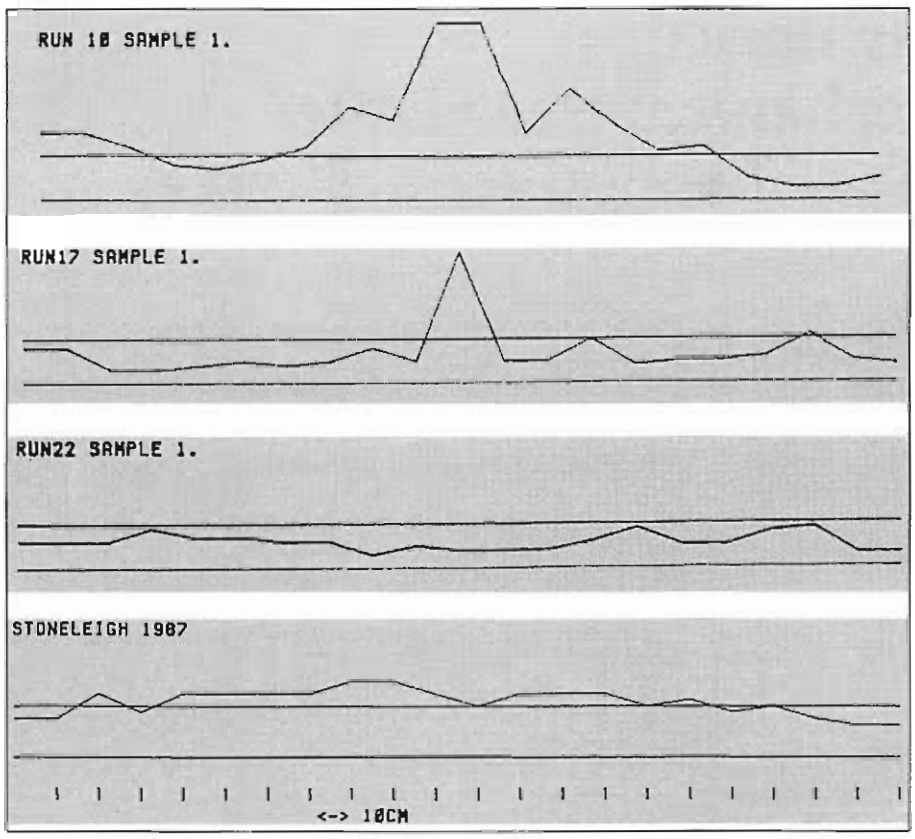
The prototype cut 12 ha of grass with no significant blade wear or knife section / ledger replacements.

Stone damage was not a problem although a number of stones varying in size from a few grams to 20 kg were encountered due to many of the tests being conducted on the outside edges of fields.

Conclusions

The conclusions of the project which involved developing a rotary shear cutting mower were :

1. low cutting powers can be achieved;
2. GRP discs with steel knives and ledgers are resistant to damage from stones etc;



Swath data

RUN 18 SAMPLE 1.
Yield per hectare = 5.492 tonnes/ha
Cutting width = 1.78m
Grass missed over cutting width = 11300mm²
Nominal cut height
Stubble height
Ground level

RUN17 SAMPLE 1.
Yield per hectare = 11.8 tonnes/ha
Cutting width = 1.9m
Grass missed over cutting width = 1500mm²
Nominal cut height
Stubble height
Ground level

RUN22 SAMPLE 1.
Yield per hectare = 16.2 tonnes/ha
Cutting width = 2.0m
Grass missed over cutting width = 00mm²
Nominal cut height
Stubble height
Ground level

STONELEIGH 1987
Yield per hectare = 30.75 tonnes/ha
Cutting width = 1.9m
Grass missed over cutting width = 3675mm²
Nominal cut height
Stubble height
Ground level

Fig 7. Stubble height profiles for 4 runs.

3. uniform stubble height can be obtained;
4. machine maintenance is not significantly higher with shear cutting machines and should not prevent development and
5. high spot work rates are possible.

Post Script:– Professor Sverker Persson (1993) of Pennsylvania State University recently demonstrated a similar prototype counter rotating shear cutting mower. This machine showed similar performance to the Newcastle University prototype.

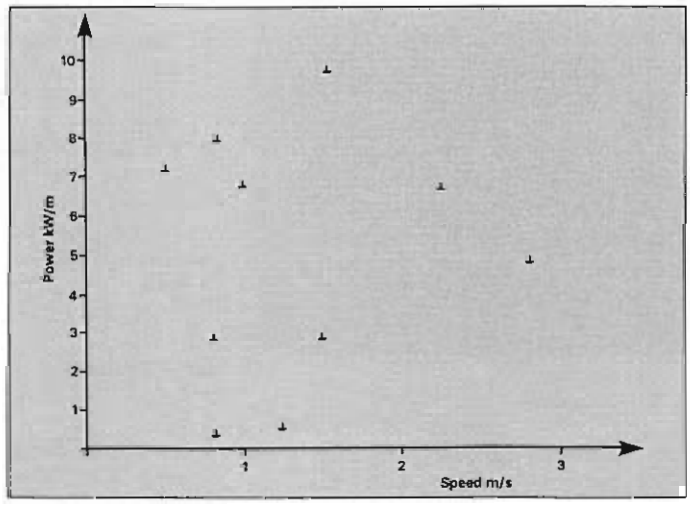


Fig 8. Power versus forward speed for the mower.

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QUOTES / SHORTS

Farm incomes in the United Kingdom rose by over 10 per cent in real terms in 1992.

John Gummer, Agricultural Minister, 26 Jan 1993

A 100 cow dairy unit produces more waste than an average sized village – some 5,200 litres of effluent comprising slurry and dirty water. That quantity could easily be doubled with hard rain on a concrete yard.

Farming Facts II

Even with crop protection we lose 45% of our potential food production.

Farming Facts II

In the UK some 45% of farmers have less than 50 acres of farmland and the average farm size is 175 acres.

Farming Facts II

Passive smoking at work

Under new regulations employers will have to ensure that there are arrangements to protect non-smokers from discomfort caused by tobacco smoke in rest rooms or rest areas. These regulations will come into force in 1993 for new workplaces and in 1996 for existing workplaces.

Under the existing Health & Safety at Work Act 1974 employers have to ensure as far as is reasonably practicable the health, safety and welfare at work of all employees. Under this Act, for instance, it would be illegal to force a worker with a reparatory condition to work in a very smoky atmosphere. Recent civil cases have also highlighted potential liability in this area.

AGM Service, March 1993

A furrow opening device for a mechanical tree planter

Paul Dawson and Ian Yule report on a design project undertaken at the University of Newcastle upon Tyne and which was partly sponsored by the Forestry Engineering Group of the Institution.

The aim of the project was to produce a furrow opening device to be used in conjunction with a mechanical tree planter for agricultural land. The furrow opener will improve the site into which the trees are planted. The device should provide an optimum balance of soil aeration, drainage and cultivation together with the suppression of vegetation already present.

The main application of the Forestry Engineering Group award was in carrying out a field survey, talking to experts in the UK on matters of tree planting and establishment.

It seems that foresters are rather like economists, in that if you talk to twenty of them you get twenty different opinions. However, this seemingly confused situation could be categorised in relation to the planting site and it was clear that one of the main factors to consider was soil type.

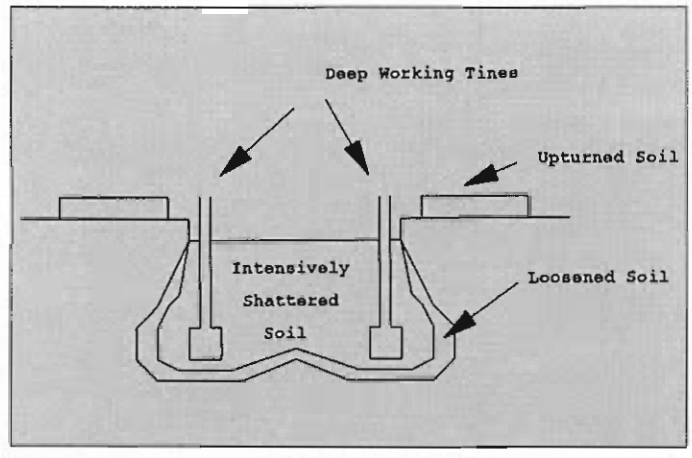

Fig 1. The effect of the furrow opening device on the soil.

used in all soil types it was decided that the approach of using a toolbar should be adopted, so that different elements could be mounted where appropriate. A design specification was drawn up:

- Assuming the presence of turf, a furrow up to 100mm deep and 300mm wide needs to be cut. The turf opener could be easily removed when not required.
- The turf removed from the furrow should be cut in the centre, upturned and placed on either side of the furrow to leave a weed free area.
- Cultivation within the furrow should be possible down to a depth of 400mm.
- Both cultivation and furrow depth need to be adjustable.
- Both the turf opener and cultivating tines need to be removable in order to configure the machine to be site specific.
- The furrow opener and tines will incorporate some form of break-back mechanism in order to protect the machine against unseen obstacles.
- The machine is required to fit a category two, three point linkage of an agricultural tractor.

Fig 2. The furrow opening device in action.

Design specification

In order to design a machine that could be

Construction

Most of the design requirements were satisfied.

The unit was mounted on the three point linkage. Three 450mm plain discs were used to cut the turf. These were located on a single axle, adjustable in relation to the implement frame. Both the furrow opening device and the tines were mounted on a toolbar which was protected by a shearbolt. If the plough hit an obstruction and the shearbolt failed, the toolbar would rotate around its own axis in order to clear the obstruction. The toolbar was mounted onto the implement frame by means of two 30mm diameter

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P A Dawson (right) is a Final Year BEng AgEng student and I J Yule (far right) is Lecturer in Agricultural Engineering, Department of Agriculture and Environmental Science, University of Newcastle upon Tyne.

See inside back cover for details of the Forestry Engineering Specialist Group awards. Closing date for entries this year is 1 July.

Alternatives to shortwood working

Forestry Engineering Group: Symposium

Geoff Freedman reviews the programme – *see back cover for full details*

There is nothing new in the concept of alternatives to shortwood working. In fact, excluding the last 15 years or so, harvesting in Britain's forests was based solely on alternatives to shortwood working. In support of this statement, one can refer to Forestry Commission statistics, which show that in 1981 they owned 258 skidders and 80 cablecranes, which between them extracted 70% of the total volume; by 1992, the equivalent figures were 21 skidders and 23 cablecranes, extracting 10% of the total volume.

There can be no doubting that the switch to shortwood working throughout the 1980s has resulted in major efficiency gains within the industry. From the late 1980s onwards, further benefits have been produced through mechanising the felling, processing and conversion operations within the shortwood system of working.

The symposium will begin with David Balfour, BSW Sawmills Ltd. As a major purchaser of roundwood from British forests, David will explain the sawlog requirements of a modern mill targeted at producing timber for the construction market. He will highlight the problems posed by crops of variable form, and linking back to the first speaker of the day, review the milling of shortwood logs in contrast to log poles.

This will be followed by Dr Bob McIntosh, Forest District Manager of Kielder Forest District, Forest Enterprise's largest production forest. Bob will explain how, in order to reconcile the roundwood needs of his principal customers in construction-based sawmilling, with mechanised working of 'Borders crop types', it was necessary to evolve an alternative to conventional shortwood working. He will detail the evolution of the system, crop selection, site planning and logistics and outputs. Whilst still forwarder-based, it will become evident that the system is anything but shortwood working!

Next is David Killer, Forest Enterprise's Harvesting and Civil Engineer in Wales. David will detail a second alternative system to shortwood working, which has, as one of its primary objectives, the reduction of subsequent restocking costs. Inspired by clambunk working, the result is a fully mechanised system which is able to meet the aspirations of both harvesting forester and silviculture forester. David will outline the system, discuss site selection and requirements, and review performance to date.

Managers may be innovative and redesign working systems, but the success or otherwise of their endeavours, will amongst other things, be dependent on the design and manufacture of cost-effective harvesting machines, which are capable of meeting the system's needs. The third speaker from The Machine Shop has been involved as a forestry machine agent for many years. He was closely involved with production of machines to service the systems outlined by the previous speakers, and he will provide a machine manufacturer's perspective of responding to the 'innovative' needs of the customer. He will review the information required by the manufacturer, highlight the engineering principles to be considered and the problems and solutions faced, in amending existing machines.

This will be followed by Mike Crow of Iggesund Forestry (UK). Operating in the west of Scotland, Mike has a wealth of knowledge of cablecrane systems. He will outline how, through the drive for increased efficiency, via mechanisation, an alternative to conventional shortwood working has developed. A review of steep ground mechanised systems will be presented including: machine requirements and attributes; site factors; balancing outputs within the system; safety considerations and outputs.

Several of the alternatives to shortwood working involve roadside processing, which produces large quantities of residues at roadside. Residues require space, sterilise ground, can be unsightly and pose a fire hazard. The next speaker, Barrie Hudson, Operations Manager of the Forestry Contracting Association, who as a former research fellow at Aberdeen University, investigated 'mechanised harvesting systems for wood fuel', will suggest how, what at first may be seen as a problem, can be turned into a market resource. He will review the alternative mechanical treatments for residues, machinery and system requirements, products and potential market outlets, outputs and costs.

As in previous years there will be a discussion period at the end of the day for about one hour led by our distinguished chairman. This session will belong to the Symposiasts who, after all, are the real experts.

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shafts welded into plates on the end of the toolbar. These were held using bushes which were attached to the side members of the implement frame.

The furrow opener takes the form of a double sided mouldboard, the depth is adjustable. Two tines were attached to the toolbar by the same means, these provided the deep loosening; where required depth can be adjusted in 50mm increments. The tines can also be adjusted in the horizontal plane to provide a wider cultivated zone if required.

Results of tests

Although most of the design objectives were met, under test the most persistent problem was to eliminate the clear strip between the furrow and the upturned soil. This would allow unretarded weed and grass growth which would be detrimental to young trees.

The actual furrow created was most satisfactory, typically a 40mm deep furrow was cut, the optimum width was 300mm. The tines were placed at either edge of the furrow and provided a well broken and aerated area to a depth of 300mm. The action of the implement is illustrated in Fig 1. The tree would be planted in a slot in the middle of the furrow and it is envisaged that forming rollers would be used to firm the soil around the tree and ensure that roots were not left exposed on the surface. Fig 2 illustrates the unit in use.

As stated previously most of the design objectives were met though the plough does require further development in order to overcome one or two problems encountered in field testing.

Acknowledgement

The authors wish to acknowledge the invaluable financial assistance given to the project by the Forestry Engineering Group of the Institution and express their gratitude for that support.

Forestry Engineering Prizes

The **Forestry Engineering Specialist Group**, always looking for ways of encouraging young engineers to take the initiative, is offering a £200 cash prize to each of two students for written assignments produced as part of their course-work.

The prizes are personal and may be spent on anything the winners wish. See inside back cover for full details.

From strength to strength ...

The money that enables the Forestry Engineering Specialist Group to offer the prizes comes from a series of very successful seminars. The 'Low cost roads' seminar held in March continued their successes. Seventy-five delegates heard nine eminent speakers explain the techniques, trials and tribulations of providing unsurfaced roads capable of withstanding lorries and forestry equipment economically and reliably.

The role of automation and computerisation in UK irrigation

An improvement in precision and in monitoring methods of irrigation, says Colin Friedman, should both increase the farmer's income and protect the nation's national resources.

Recent years have seen an increase in the realisation that water is a scarce and fragile resource that has to be managed correctly.

A commonly held concept of UK irrigation is that since it is only supplementary to rainfall and returns from irrigation are marginal there is no need for precision irrigation. However, it is exactly because of this slim profit margin combined with the necessity for irrigation to become environmentally friendly that precision is required.

A lot of time and effort has been devoted to determining accurate scheduling methods but the application methodology seems to have been relegated to the side-lines. An improvement in precision and monitoring methods should both increase the farmer's income and protect the nation's natural resources. This required improvement is achievable through automation.

The pursuit of irrigation efficiency should be an integral part of farmers' and irrigation experts' daily existence.

Computerisation can increase profitability through precise irrigation, control of timing (not irrigating in windy conditions, pulse irrigation), proportional fertilisation, the ability to relate to the micro-climate and the possibility to determine the amounts according to agro-technical considerations (tensiometers, pressure chambers, evaporation pans, etc).

Water can be conserved by knowing exactly where each cubic metre went, by being able to trace and shut down leaks and bursts in seconds and by irrigating in optimum conditions. Energy can also be conserved by operating pumps at optimum efficiency.

Advanced computerised irrigation schemes exist in countries such as the USA and Israel. However, the market in the UK is almost non-existent despite the fact that the very nature of supplementary irrigation necessitates accurate and effective use of water in order to profit from irrigation.

UK irrigation – climatic change will bring increased demand

Long-term climatic predictions suggest that within years the south eastern and central southern areas of England will climatically resemble central and south western France of today and that northern England and Scotland will emulate today's southern England (Jones, 1990).

Water restrictions and even water rationing have been necessitated as the result of dry hot summers such as 1975, 1976, 1984, 1989, 1990. The addition of the forecasted temperature rise of 3°C and possible reduction in both seasonal and annual precipitation will in turn lead to an increase in water usage both for domestic and agricultural purposes.

C Friedman is a Soil and Irrigation Consultant for the Israeli Ministry of Agriculture.

There are a number of ways to prepare for future requirements all of which demand urgent action to be taken now if they are to be relevant.

Conservation of resources is the most appropriate as both a short-term solution and as a partner in any long-term solution. Conservation demands research into cultivars that can produce high yields on minimum water requirements. It also demands the effective use of each and every drop of water used for irrigation.

Irrigation in the UK is supplementary to rainfall and therefore the number of hectares irrigated and the volume of water used in any one year is directly related to that year's precipitation.

Table 1. Area of crops irrigated in hectares. (after MAFF)

Crop	*Area irrigated (ha)*			
	1982	*1984*	*1987*	*1990*
Potatoes harvested by 31 July	8,050	7,720	5,360	8,510
Potatoes harvested after 31 July	22,810	34,610	29,520	43,490
Sugar beet	15,770	25,500	10,110	27,710
Orchard fruit	3,100	3,250	1,330	3,320
Small fruit	3,610	3,560	2,230	3,470
Vegetables for human consumption	14,810	17,460	11,040	25,250
Grass	16,440	18,940	6,970	15,970
Cereals	14,800	24,700	7,510	28,100
Other crops	4,100	4,890	2,440	8,650
Total area irrigated (ha)	103,490	140,600	76,520	164,460

The Ministry of Agriculture, Fisheries and Food (MAFF) conducts a survey approximately every three years in order to try and determine the extent and nature of irrigation in the UK. Unfortunately, the wording in a questionnaire can easily influence the results obtained. An additional problem with the data collected is that it entirely depends on farmers voluntarily providing the requested information.

The survey also does not seek to collect data on the reasons limiting a farmer to a certain irrigated area. Is the limiting factor water availability, labour requirement, financial or a mixture of reasons?

Information presently available (MAFF, 1983, 1986, 1988, 1991) is limited to four sets of data. It has to be noted that 1984 and 1990 were exceptionally dry years and 1987 an exceptionally wet year.

It is interesting to note the change in irrigated area as a direct result of climatic variation. The survey also shows a fluctuation in the volume of water used corresponding to the climatic variation. The greater volume of water can be explained by the crop reaching the critical soil moisture depletion level more frequently. The increase in areas irrigated (1984, 1990) can only be explained by marginal areas becoming dependent upon irrigation in order to avoid yield and/or quality reduction. It also supports the assumption that future climatic changes, as a result of global warming, will lead to an increased need for irrigation in the UK.

Water conservation essential – for profitability and to safeguard resources

Automation does not appear to be high on the irrigation agenda in the UK and computerisation is almost a foreign concept. Irrigation itself is only regarded by some as an insurance policy.

Most farmers and irrigation personnel have identified the need for irrigation and have also established the importance of correct scheduling (including the establishment of computer based scheduling services). The control though of water delivery has been relegated to the sidelines. This is a mistaken approach and efficient control is vital in order to conserve resources, to increase crop quality and quantity, and to obtain the maximum benefits from accurate scheduling.

Irrigation like any agricultural tool has to be handled properly in order to give maxi-

mum benefit and in some instances to avoid causing damage. Poor control can result in certain areas receiving too much water and others not receiving enough. These problems can obviously be caused by incorrect scheduling but the point that has to be made is that they can also be caused through bad control and lack of uniformity (which in certain instances are inter-related).

Arguably, the main factor affecting distribution uniformity is the wind speed. Sophisticated control systems can combat this element by halting irrigation during excessive wind speed events and recommencing when the wind is below a set critical speed.

Defining the control requirements

A definition of requirements is needed in order to determine which of the various control and command levels is appropriate to the specific case being considered. In general terms the justification for the upgrading of a system from one command level to the next is based on the expectation that an increase in profitability will be achieved.

Automation – computerisation – may increase benefits by increasing yield.

Savings may also be expected – for example, in water and energy requirements. Furthermore, the day could be exploited to the full with a choice of twenty-four out of twenty-four hours. The irrigation schedule can be based on the cheapest power rates and not dependent upon the sociability of the hour. The number of person hours could be reduced (less people per shift and less time required to collect data).

It must be noted that automatic irrigation can be expensive, requires trained personnel and may necessitate staff retraining. These drawbacks have to be costed and balanced against the possible benefits.

An ideal solution therefore will operate the irrigation system efficiently and will contribute to savings in water, energy and person hours.

When choosing the correct system one must prepare a list of requirements and compare them with the manufacturers' suggested solution. Nearly every case will be different and therefore the ideal solution will always be site specific. The check list here presented is offered as a guideline for determining which requirements are relevant.

The choice of automation will also be affected by the command transfer ability of the system in relation to site specific requirements. Equipment sophistication may be reflected in the ability or inability to operate solenoids, the maximum distance a solenoid may be placed from the command module, the ability to use radio signals, the ability to use telephone lines or the type and number of wires required.

Case studies

Four case studies were examined (Friedman, 1991) in order to try and determine what equipment is typically in use, to identify problems and to attempt to find acceptable solutions. The four case studies were chosen to represent four different facets of UK irrigation:

- soft fruit,
- top fruit,
- field crops,
- golf courses.

In all instances the same questionnaire was used both as a basis for discussion and as a common denominator for comparison. The conclusion reached in all four of the case studies was that improvements could easily be achieved through the introduction of automation.

On the wider scale, there is, regrettably, very little literature on the subject and despite the growing importance of conserving energy and water very little attention is being paid to the benefits that can be obtained from precision command and control systems.

The lack of literature and statistics means that it is impossible to identify how representative of the UK irrigation scene are the four subjects of the case study. They were chosen in good faith based on the recommendations of the United Kingdom Irrigation Association (UKIA). That, by definition, may mean that they are not representative of farms and golf courses in general but they may be good examples of irrigated sites.

The quoted examples of soft fruit, top fruit and golf courses identify a strong need for automation and in general it is in these areas that the manufacturers are concentrating.

In the fourth example (field crops) automation is definitely required for the pump house but it is questionable whether or not it is economic to connect the hosereels to that same command centre.

It is possible to connect the hosereels using either flowmeters, microswitches, flowswitches or a combination of all three. The control units should be located on the hosereel and 'plugged in' to a weather protected socket that would have to be located next to each hydrant.

It is impossible to obtain full automation with hosereels since they require manual intervention to prepare them for the start of each cycle. It is possible though to obtain, through the use of the previously mentioned equipment, semi-automatic sequential irrigation. This could be advantageous in situations where there are problems of pump command, or when irrigation initiation occurs at inconvenient times.

Check list
to determine irrigation control requirements

- Irrigation by amount.
- Irrigation by time.
- Fertigation by amount.
- Fertigation by time.
- Proportional fertigation.
- Operation of hydraulic valves.
- Reception of input.
- Operation of alternative conditional programmes.
- Provision of real-time situation updates.
- Quantification of water and fertiliser use per area.
- Provision of a hard copy of desired information.
- Listing of all faults in network on one screen.
- Cleaning of filters according to elapsed time.
- Cleaning of filters according to pressure difference.
- Cleaning of filters according to amount of flow.
- Operation of alarm in case of fault.
- Adjustment of irrigation amounts in accordance with daily evaporation readings.
- Identification of faults through addition and subtraction of recorded flow from the flowmeters.
- Operation of pumps according to time.
- Operation of pumps according to changes in pressure.
- Operation of pumps according to changes in flow.
- Operation of irrigation schedule optimisation.
- Optimisation of programmed schedule.
- User friendly.
- No loss of memory as a result of power failure.
- Simple maintenance and manufacturer support.
- It is also necessary to verify that the command system's number of available inputs and outputs is not only greater than the total requirement but also leaves room for future expansion.

Conclusions

- There is a lack of professional literature.
- There is a lack of information and statistics regarding the situation in the UK.
- There is a forecasted growing need for irrigation in general and automation in particular.
- There is a genuine role for increased automation in the current situation.
- Water management in the UK is based on elapsed time despite the superiority of flow metering.
- There is a lack of awareness of the need for automation as a conservation measure.
- There is a lack of awareness of the social and economic benefits automation could bring.

Further research ...

The various agricultural colleges and universities should seriously examine their role *vis a vis* not only the foreign students but also the UK students.

It is true that the majority of irrigated land is un-pressurised surface irrigation but that does not negate the importance of the advances and changes being made in the world of pressurised irrigation.

Prof Jack Keller in a seminar held at Silsoe College (20-21 May 1991) talked about the spread of sophisticated drip equipment in India, which is a country typically associated

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'Better by Design'

The 1993 Convention

Silsoe, Bedford, 18 May 1993

The event started with the Annual General Meeting of the Institution at which **J B Finney CBE** was re-elected **President** for a second year.

Conference

The AGM was followed by the Conference **'Better by Design'**.

The Keynote Address was given by **Mr R (Bob) Friedlander** of **New Holland Ford Ltd**. Delegates then split to attend parallel sessions with fourteen papers presented by the Specialist Groups of the Institution – **Vehicles : Soil & Water Management : Forestry Engineering : Machinery Management : Overseas Development : Electronics & Computing** and **Crop Drying and Storage**.

Mr Paul Seward, President of BAGMA, kindly stepped in at short notice to be the Guest of Honour at the Annual Dinner following the Conference.

Awards

The President, Brian Finney, presented the following awards:

– **The IAgrE Branch Meritorious Award** to **I D Gedye JP**. Mr Gedye was a prime mover in the establishment of the Wrekin branch of the Institution. During its early years he was secretary and later held successively every office on the committee.

– **The Branch Recruitment plaque** to the **Northern Branch**. For the Branch achieving the best recruitment performance in the calendar year. **Mr Ian Yule** accepted the award on behalf of the Branch.

Mr P W Palmer, Product Development Manager of New Holland Ford Ltd, then presented:–

– **The Johnson New Holland Award** to **Seamus Murphy**, for his final year project at Silsoe College on 'Design, construction and testing of three point linkage mounted device for inserting a high resolution density probe into soil';

– **The Johnson New Holland Trophy** to **Professor Bill Radley**, Principal of Silsoe College, to hold for one year.

Mr John Fox, Chairman of Bomford Turner Ltd and Chairman of The Trustees of The Douglas Bomford Trust, presented the **Douglas Bomford Meeting Award** to **Dr Andrew Scarlett** and **Mr John Reed** of Silsoe Research Institute for their paper 'Development of the Suspended Rubber Track (SRT) Tractor'.

Dr Scarlett and **Mr Reed** were also presented with the **Robert Storey Award** for the same paper, by **Mr Roger Hay** of the Institute's Scottish Branch.

Specialist Group Sessions

Papers presented at Specialist Group Sessions will be reported in the next issue of the journal.

Note: The Institution's Annual Convention for 1994 will be held at Harper Adams Agricultural College in Shropshire on May 19th.

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with non-sophisticated irrigation.

Changes are taking place on a global scale regarding the type of irrigation equipment used and its location. These changes are not limited to the distribution system but include the other elements that are part and parcel of an irrigation system such as fertigation, filtration and command and control. The time has come to include, in both long and short term programmes, sessions on automation.

Further research into the application of automation in the UK must be encouraged. The research could be directed into surveying the situation and attempting to perform detailed cost-benefit analyses. Increased competition from Europe is to be expected, climatic changes are being forecasted and ways of improving efficiency have to be explored.

. . . fact finding and promotion

Organisations such as the IAgrE, the IWEM and the UKIA should be concentrating some of their vast expertise on addressing the situation in the UK. It is not intended that they attempt to replace MAFF but should be attempting to direct MAFF's efforts and resources into areas which they, as specialised representative bodies feel are important. Magazines should be used as a forum to discuss the subject and a combined working party could be established to consider the way forward. An initial survey of farmers' attitudes to automation could be conducted via the mailing lists.

An exhibition of available equipment could be organised as part of a conference and a delegation could be sent to examine practices and procedures in places where automation is standard operating procedure. A body could be established to help the farmer define his requirements for an automated system.

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CAMERA at the CONVENTION

"BETTER by DESIGN"

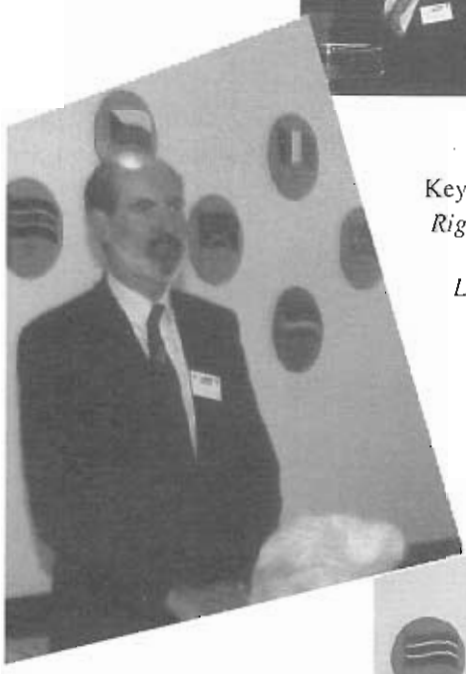
Tuesday 18th May 1993

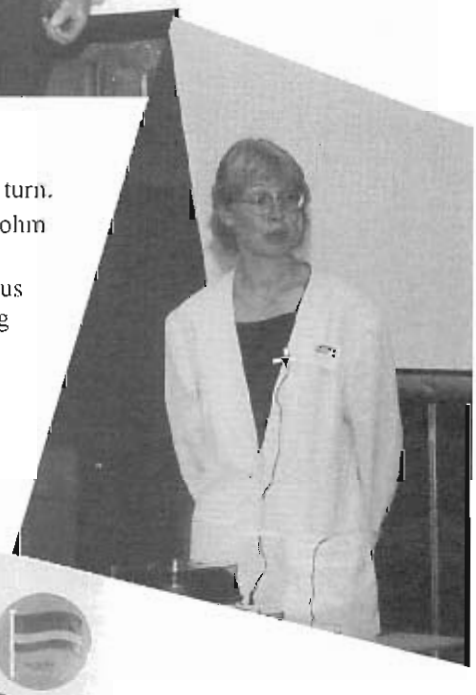
Above: President, Brian Finney *(right)*, opens the proceedings.
Keynote speaker, Bob Friedlander awaits his turn.

Right: Kaarina Ringstad stood in for Mats Bohm – no-one minded!

Left: Ian Gedye with his Branch Meritorious Award – definitely no-one minded, a long overdue accolade.

Below: Mr Palmer *(centre)* presented the Johnson New Holland Award (held by Bill Radley on *left)* to Seamus Murphy *(right)* for 1992.





Below: Simon Blackmore, just prior to extolling the virtues of computers and electronics on the BBC Radio 4's "Farming Today" programme.

Below: John Reed *(right)* and Andrew Scarlett *(centre)*, worthy recipients of the Douglas Bomford Meeting Award for 1992. Presentation by John Fox.

Golf course development – from conception to construction

Paul Campbell

Increased leisure time and a greater public appreciation of the benefits of 'sport for all' throughout the last decade has resulted in a boom in the demand for all types of amenity turf-based facilities.

The extent to which television covers major sporting events from around the world has served firstly to increase public awareness of international turf standards and secondly to heighten public expectations of their own local facility. Greater usage of established sports turf areas has highlighted the inherent shortcomings of dated designs, ie ineffective drainage, soil compaction and poor botanical composition of turf, thereby emphasising the need for greatly improved design specifications and management practices in the future (Fig 1).

Fig 1. Demand for improved design specifications and management practices.

The Demand for Golf

A recent report entitled The Demand for Golf by the Royal and Ancient Golf Club of St Andrews (1989), the governing body of the sport in Great Britain, concluded there was need for the construction of nearly 700 courses over the next ten years to satisfy increasing demand. The target ratio of courses to population by the year 2000 is one facility per 25,000.

The bulk of demand centres in and around the south-east of England where there is still considerable interest in retention of land for commercial and agricultural purposes in preference to leisure. In Scotland pressure on facilities is not as great, in fact with a ratio of one facility per 12,000 population it may appear there is little demand for new courses here.

Closer analysis of course distribution (Fig 2) and classification of courses into the clientele they service reveals three distinct types of development.

Type 1 – Large golf complexes, complete with hotel and other amenities. These are geared towards the hosting of major national and international competitions and are a mecca for tourists keen to have played on a prestige championship-standard course.

Type 2 – Private and local authority clubs amid or on the margins of centres of population. These facilities generally have long waiting lists for membership and are being played to capacity (40,000 to 60,000 rounds per annum).

Type 3 – Private clubs serving village and rural communities able to cope with local demand and accommodating passing holiday players.

It is the Type 2 club which is in greatest demand in Scotland. Formerly the limiting factor to the construction of this type of facility was the availability of sites close to towns and cities. This problem has now largely been overcome with the trend in farm diversification. A review of current planning applications for golf course construction suggests that the sport, which initially was confined to land of little value for agricultural production, will increasingly be seen on quality agricultural sites.

Feasibility studies

Typically a study carried out by Greens of Scotland for a farmer considering this route of diversification would entail a financial appraisal and a land capability study.

The financial appraisal investigates in depth the merits of the various options for business development open to the landowner:

- sale of the land with planning permission for golf;
- lease to a developer;
- development of the land prior to leasing to to an operator;
- development and operation in hand.

Other factors to be considered are:

- the demand for golf in the area;
- expansion plans of other local clubs and the earning potential from membership subscription;
- green fees and bar takings etc which could realistically be achieved.

Costed against this potential income are the

P Campbell is Senior Consultant Agronomist, Greens of Scotland, Golf Course Consultants, Bucksburn, Aberdeen.

Paper presented at the Scottish Branch Conference, 'Amenity Grass', Perth, 24 February 1993.

Membership matters....

THE NEWSLETTER OF THE INSTITUTION OF AGRICULTURAL ENGINEERS

ALL FOR ONE – the Unification Issue lumbers on

Another milestone in the uncertain progress towards major reform of the relationship between the Engineering Council and the engineering institutions was achieved at the end of April with the publication of the Interim Report from the Council of Presidents Steering Group.

Democracy

In his introduction to the summary of this Interim Report Sir John Fairclough, Chairman of the Steering Group, says: "The Steering Group has considered the options and we conclude, unanimously, that we must create a more effective relationship between the fragmented parts of the profession so that the whole becomes greater than the sum of the parts".

The report proposes changes very similar to those originally envisaged at the outset – that individual Institutions would be grouped into perhaps half-a-dozen separate 'associations' to be known as Colleges. Overseeing the activities of these Colleges and issuing broad philosophies and policies would be a Central Body made up of key personnel from the Colleges plus members (in the majority) **elected** by individual engineers. In essence a reformed and much more democratic Engineering Council.

This development would be viewed as Stage One of the process of unification. The aim of this stage would be to engender a sense of partnership between engineers of all disciplines yet still retain an element of leadership to guide the profession and speak on its behalf. Within the Colleges the individual Institutions would be actively encouraged to collaborate – leading, it is hoped, to full mergers in a short time.

Specialist Divisions

The scene would then be set for Stage Two of the proposals to be implemented – the creation of a Single Institution. This would replace the Central Body and the Colleges, though within tbe Single Institution would be a series of specialist Divisions covering different branches of engineering which would enjoy a degree of autonomy, possibly even headed by their own President and Council.

The time-scale for these changes is definitely long-term, the intention is to have a full proposal by the end of 1995 on which every engineer would then have the opportunity to decide. That is, evolutionary not revolutionary.

By the end of this year (1993) it is expected that a plan will be announced on how the present Engineering Council will evolve into the Central Body.

The Response

So how has all this been received by the Institutions? The 'Big Four' Institutions were the first to respond at the time of going to press, they being the IMechE, the IChemE, the IEE and the ICE. They issued a guarded welcome of the proposals but felt that the case for a single engineering institution was yet to be categorically made. They also question the need for the Colleges, fearing that this would create a bureaucratic tier which could be especially damaging if Stage Two did not happen. These Institutions feel that the present developing integration that is evident amongst many institutions only needs to be recognised and encouraged to achieve the same objective.

The strength of EurAgEng

If we make the assumption that membership numbers will determine the degree of influence that representations from individual Institutions will have on the outcome of the discussions, then our Institution will have to go along with whatever is decided. That, though, would be a rather misguided view since it would be ignoring the existence of EurAgEng. We have a voice, and a loud one at that, through this alliance with other agricultural engineers within Europe.

We are further down the road of European unity than the majority of the domestic institutions and that fact cannot, indeed, must not be ignored by the Council of Presidents Steering Group. Through our efforts and negotiations to harmonise the agricultural engineering profession within Europe we have invaluable experience within our ranks, experience which will be only too welcome when what has to be the ultimate aim of the Single Institution is announced – the unification of the engineering professions of Europe.

Queries and correspondence relating to this Interim Report are invited and should be addressed to: The Project Director, Council of Presidents Steering Group, c/o The Engineering Council, 10 Maltravers Street, London WC2R 3ER.

Additionally, to give Engineers the opportunity to voice their views, the 'Big Four' are also staging a number of regional discussion meetings around the country. Details of meetings, end-June onwards, are given on page 61 of this journal. The meetings are open to all engineers whatever their parent Institution.

Copies of the Executive Summary are available for the price of an A4 sae with a 24p stamp from the above address, as is a copy of the full report for which a cheque for £10 payable to: 'The Engineering Council' must be enclosed.

Copies of the full Report are held at the Secretariat for loan to members – contact Mike Hurst for your opportunity to see the document and comment on its content. Indeed, Mike would welcome your comments since he needs to know the views of the membership. Don't let him down!

Membership

Admissions – A warm welcome to the following:

Member J U Attah (Bedford)

Associate Member I M Harris (Wales); L L Kaluba (Bedford); J P Emery (Kent); T D Eyre (Worcs); T E Omoniyi (Bedford)

Associate J J Evans (Glos); C Husker (Scotland); M T Woldegiorgis (London); D A Yates (Notts); S M Jenkins (Wales); J A Cambridge-Clarke (Essex); P N Leach (Lincs)

Student M R Horsley (Yorks); J A Blake (Surrey); V R Emerson (Wilts); S R Honeywood (Suffolk); T E Horlock (Herts); R J Brindle (Scotland); K Devine (Scotland); Y Sun (Bedford); J M Greatorex (Bedford); P D Hallett (Bedford); A J Hambley (Scotland); K-L Weiner (Bedford)

Re-instatements/re-admissions – welcome back!
J Tyblewski (Northants); S Haresign (Bedford); J D Payne (Hants); P R Williams (Devon); C J Darcel (Dorset); C R Waterfield (Essex)

Transfers – congratulations on achieving the next step
. . . to **Member** K H O Eltilib (Middx); U M Oo (Burma); D W Tilbury (Leics); N L Warner (Glos); D J Wilson (Cornwall); V A Gainey (Berks); S Loneskie (Scotland); P M Stearne (Hants)

. . . to **Associate Member** M C Thorne (Warks)

. . . to **Associate** R C P Green (Bedford)

. . . to **Students** P J M Krause (Scotland); Z Nedic (Shrops)

Resignations – thank you for your support, we wish you well in the future
J S Azimraieyat (Bucks); B J L Hall (Hants); W W James (Hereford); D H Russell (Avon); J M Boardman (Lancs); P Moran (Bedford); G C Morris (Glos); D H Rowe (Warks); E R Collins-Hughes (Eire); M K Newman (Beds); I H Provan (Scotland); I S Rickwood (Somerset); B A Sims (Worcs); R C Tilbrook (Cambs); I M Tring (Surrey); P R Williams (Warks)

Deaths – with sadness, and sympathy to those left behind
C J McLintic (Oxon); J W Turnock (Bucks)

Engineering Council registration – congratulations to the following on their election to the grade indicated
CEng P M Stearne (Hants)
IEng S Loneskie (Scotland); J H Ward (Swaziland)

Movements – the following have moved to a different county/country
P S Barton (Australia to Uganda); C Clinton-Carter (Hants to Wales); C S Cornish (Oxon to Devon); G E Diggins (Kent to Qatar); G Ovens (Zambia to Ghana); L F Waldmueller (Kenya to Tanzania); L B Cheal (Berks to Malawi); C J Conner (Lancs to Netherlands); A D Barber (Italy to Suffolk); A G Chadborn (Suffolk to Uganda); S M Friederich (Surrey to Honduras); J E Gregory (Hants to Surrey); E M Lee (Bucks to W Midlands); P M A Radford (Yorks to Cambs); G B Sanders (Herts to Lancs); J W Turnbull (London to Oxon)

Obituary

Harry J Carnall, CEng, FIAgrE, MiMechE

Harry Carnall, Institution member for 41 years, died suddenly on 20 May. It was in keeping with his long association with the Institution that his final contribution, that of convening the Annual Convention of 18 May, was an outstanding success. I left him at 10pm on that evening still full of zest and pleasure at the way the day had gone, and still in cheerful conversation with the remaining dinner guests. That is how I hope he will be remembered.

Harry was trained during the early war years and after the war as a draughtsman and mechanical engineer. Between those times he served nearly four years in the Royal Air Force as a flight engineer and draughtsman. On completing his training he joined Rotary Hoes Ltd, and thus began a working life in the farm machinery industry, where he served a number of companies in senior engineering positions, and finally headed Carnall and Associates, consulting engineers.

The list of appointments that he held at East Midlands Branch and national level is lengthy. He was Branch Chairman, Vice-Chairman, and Treasurer at various times. He was a national Vice-President, Honorary Treasurer, and Fellow on Council, and made special contributions on the CEng sub-committee, the Awards Panel, and the Executive Committee. He was a valuable guide to those progressing to CEng status. In Executive meetings Harry would imply that he was 'difficult'. The fact was that his sharpness of mind and reluctance to accept half-answers brought the best out of those around him.

He will be sadly missed by the industry, Institution members, and his particular friends in the Institution Secretariat. We offer our condolences to his widow and family.

Brian Finney, 24 May 1993

Get it right!

Randolph Ladbrooke has recently voiced his concern over a matter about which he is one of the best qualified to comment. The matter in question is the use of the designatory letters showing registration with the Engineering Council – he has noted that many members of institutes and institutions such as ours (and including members of our Institution) persist in using out-of-date titles.

The use of these 'old' titles dating from a now-defunct organisation leads to confusion and a suspicious regard for the claimant. Indeed, it clearly demonstrates that the claimant has not kept up to date with engineering matters leading the reader to conclude that that person's engineering ability and expertise is highly suspect and not to be trusted.

So check your business cards, letter heads, company literature and company profiles today, make sure you are not one of the culprits – it's in your own interest. Remember that the only designatory letters recognised by the engineering professions are: CEng; IEng and EngTech.

And who is Randolph to scold miscreants like this? He has held several positions of high office within the TechEng Board and the EngTech Board in their day, was on the Engineers Registration Board General Assembly for many years and was, in fact, Chairman of the ERB when it was handed over to the Engineering Council. QED!

More Prizes for Young Engineers

The Engineering Council's Young Engineers for Britain (YEB) competition is now well established as the principal means available to youngsters to show off their ingenuity in engineering. However, the organisers were aware that many of the projects submitted, though they lacked the presentational and marketing attributes required by the YEB competition, nevertheless displayed remarkable engineering skill and imagination.

In an effort to reward these projects the EC have decided to run a second competition in parallel to the YEB, to be called: The Innovation and Inventiveness in Engineering Award. Sponsorship has been secured from Cosworth Engineering. The scheme will involve assessors attending the regional finals of the YEB and selecting a further project from each which particularly demonstrates engineering inventiveness. Full details from the Engineering Council.

NRA Exposé

Herts & Essex Branch **(P.H.)**

With the National Rivers Authority in the news so much of late as they strive to clean up our country it was appropriate that the Herts & Essex Branch teamed up with the Essex Grassland Society to outline the work of that Authority. This is a summary of that meeting reported by **Paul Hill**.

The speaker, Mr Steven Dines, initially described the responsibilities of the NRA and differentiated between them and the Water Companies. The Water Companies look after the water supply and the disposal of dirty water. The NRA have a much wider remit, they are responsible for resource management, conservation, recreation, flood defence and pollution control to name a few!

The NRA is split into 10 regions, shortly to be reduced to 8. Mr Dines is employed in the Eastern Region, an area with a population of 5 million using 1.5 million cubic metres per day stretching from Lincolnshire to Essex. Of the 600mm average annual rainfall over this area some 450mm is lost by evaporation necessitating the transfer and importation of water from nearby areas.

The logistics of ensuring everyone in the Region has adequate water is the 'resource management' function mentioned above, and Mr Dines' prime responsibility. This sector of the NRA's work involves the determination of available water and the control of the supply. Rainfall is constantly put against evaporation and run-off to monitor the level of reserves, both above ground and in the aquifiers below. To offset the natural variance in supply the Eastern Region are considering further storage means – reservoirs are the obvious but the replenishment of below-capacity aquifiers is another option.

The control of water use is backed up by the 1991 Water Resources Act which defines when a licence is or is not required, and Mr Dines summarised the latter instances. The issue of an extraction licence is not something that is done lightly since, once issued, it is very difficult to revoke. A great deal of research into the effect that the proposed extraction would have on the water supply must be done to ensure that over-use does not endanger the environment around and down-stream of the extraction site.

When reserves are being used to an uncomfortable degree, say in a dry summer, it is the Resource Management Section's responsibility to issue Drought Orders and fines on users who blatantly ignore these or exceed their quota. On that slight show of the NRA's 'teeth' Mr Dines concluded his presentation of an informative paper.

Tyres and Telephotos

Wrekin Branch

The Wrekin Branch have boosted the appeal of their winter programme of meetings by adopting a sequence which incorporates two visits and four technical papers in place of the 'traditional' six technical papers. This year the two visits were to the **Goodyear Tyre** factory at Wolverhampton and the **Joint School of Photography** at RAF Cosford.

Anyone who hasn't seen tyres being made, or who has griped at the cost will be impressed at the sight. The huge investment in plant and man-power will make the most hardened accountant wince.

The group were treated to a guided tour from the raw rubber latex as received from abroad through to the finished product – new Goodyear 70 series tractor tyres, and all points between.

To itemise every stage in this report would be tedious, and is well documented in the text books, suffice to say that to see it happen was fascinating. An excellent evening, our thanks to Dave Richards – Goodyear's agricultural tyre specialist, for setting up the visit.

Raw recruits to skilled photographer in 26 weeks, that's the challenge facing The Joint School of Photography at RAF Cosford at every intake, and they do it with aplomb!

The recruits come from not only the Air Force but also from the Army, Navy, Royal Marines, the MoD Police and, such is their reputation, from the Services of countless other countries.

The visit started with a look at the equipment used, both old and new, and a selection of the results of using it. The students are trained in all aspects of photography from photoreconnaissance to portraits and still life – after all, an RAF photographer will be expected to change and process film from a Tornado and then, perhaps, move to taking press photos of an auspicious occasion or VIP all in a day's work!

Another fascinating evening which fully justifies the Wrekin Branch's change in policy. Thanks for this one go to Dave Humphrey, a civilian instructor at the School, and Sgt Ian Dunning who is an Army instructor on secondment to Cosford.

R&D in Colleges – how to succeed?

West Midlands Branch **(M.S.)**

Professor Dick Godwin of Silsoe College is not renowned for pulling his punches and this evening presentation to the West Midlands Branch appeared to be no exception.

The title of the meeting was 'The Role of Colleges in Research and Development' – an area in which Prof Godwin is well qualified to comment, and comment he did in his inimitable way!

After an initial overview of the value of MPhil and PhD work to Silsoe College he moved on to how to be successful at research work – maximising the profit margins and selecting very good students being Dick's basis for success.

Taking the latter point first, if only the best students are selected for research work the reputation of the academy will be enhanced and the process can be expected to 'snowball'. A better reputation will attract a greater pool of postgraduates from which to make the selection, and in turn attract outside contracts to do research.

As for maximising profit there was plenty of advice on how this can be achieved. Well motivated staff concentrating on durable future problem areas, and working very hard to achieve results are key features. Publish the results wherever possible to show the world that the academy means business and don't be disheartened by the 'flak' that is bound to come. Persistence and determination will be rewarded with contracts for work.

Any profit that is made will be small, this is no 'gravy train' by any means, and will rarely seem to justify the frustration created during the project. Frustration which will only be exacerbated if the work is attempted in a piecemeal fashion or if the world of intellectual property (patents and royalties) is entered.

In conclusion, work hard on integrated, sustainable programmes and keep overheads to an absolute minimum.

Visitors to Silsoe College will recognise this philosophy and see evidence of its success. Thanks to **Mike Sheldon** from whose report this summary was gleaned.

Job File

Those that profess to know tell us that we have turned the recessionary corner and economic recovery is showing signs of happening. If this is true, and there does appear to be some substantive evidence, then British agricultural engineering must get in at the start to ensure a lead over its international competitors.

With expansion comes a demand for employees. The Institution is well placed to act as an intermediary, holding news of vacancies and passing on those notified to members looking for a change.

Some years ago the Secretariat operated a more structured 'agency' system until the first recession bit and the jobs dried up. Indeed, this new initiative may so develop but for the time being it seems prudent to hold vacancies at Silsoe for dissemination to members who enquire. Naturally, all enquiries will be treated in strictest confidence. The system will operate for an initial period of six months and then be reviewed.

So, if you are looking for employees why not send details to Mike Hurst. The service is free and you will be targeting the cream of the agricultural engineering profession. If you are considering a move, drop a line to Mike with an indication of the areas of work that are relevant. Together we can make it happen!

News of Members

Tony Chestney

Since taking over the News of Members column from John Hall I have been encouraged to receive several letters from members. The first one was from **Peter Stewart Barton** *who is now working on a UNIDO – funded project for the rehabilitation, re-equipment and staff retraining for the Soroti Farm Machinery Factory. Stewart would like to meet any other members living in or visiting Uganda. He can be contacted at: c/o Kagga & Partners Ltd, PO Box 6583, KAMPALA. Tel. and Fax: 220091.*

The second letter was a very interesting one from **Roger Stevenson**, *now in Thailand. Roger was stimulated into writing on the receipt of his 25 year membership certificate (well done on that score!). He joined the Institution as a student doing an NDAgrE at Writtle. After Writtle he went to Kenya with the VSO to teach farm mechanisation and crop husbandry.*

Returning to the UK Roger was employed as a salesman with an irrigation company before going to Swaziland. Here he met up with John Neville who encouraged him to come home to do a course at the then NCAE. This he followed with an MSc at Reading. Since then he has worked in over 20 countries around the world and for the past 11 years has been travelling to and from the Far East.

Roger now works in Thailand on a 47 million ecu project funded by the EC for the Royal Irrigation Department of the Thai government. The project covers 10 separate irrigation schemes in 7 different provinces with a total area of 50,000 hectares. His letter continues with interesting information on rice production and the need for mechanisation, particularly with the planting and harvesting operations. Thank you Roger for so much information.

We hear that . . .

David Moreland *has been appointed Field Sales Manager for Howard GB Ltd. David gained an HND in Agriculture at Writtle followed by an Advanced Diploma in Farm Mechanisation. He is also a qualified ATB instructor (let us hope that the recent changes in the ATB leave him, and others like him, an organisation to represent!).*

Carl Boswell *has retired from his post as Chief Agricultural Inspector with the Health and Safety Executive. Over the years that Carl has held this position there has been a welcome decline in the number of accidents in our industry – testimony to his leadership of this vital service. Well done, Carl, may your retirement be long and safe. Carl is succeeded by Frank Lindsay, previously of the HSE's Accident Prevention Advisory Unit and not a member, yet!*

Coffee producers in Northern Tanzania will soon be getting to know another of our members – Dr **Eric Whiteside** *has recently taken up the appointment of Coffee Agronomist in that part of the world.*

Still in that continent and just a smidgen north of the equator is **Bob Berry**. *He is Resident Manager of the Kenya Fluorspar Company's opencast mine at Kimwarer in the Kerio Valley. 500 people in his employ produce around 100,000 tonnes of Fluorspar (calcium fluoride) per year. Situated as he is in the mighty Rift Valley he enjoys views of the escarpment rising abruptly 5,500ft from the valley floor and then continuing to over 9,500ft – "one of the most beautiful spots in Kenya" is how he describes it. At the time of writing Bob was looking forward to having the Safari Rally pass his doorstep en route to the 15 miles and 25 hairpin bends of the escarpment road. Sounds idyllic!*

Plastered again?

The photo shows **Hugh Miller** *recovering from an immense(ly) satisfying meal on the occasion of the Southern Branch's AGM and Annual Dinner. Cynics may wince at Hugh's apparent lack of dress sense – odd shoes may be de riguer at the local disco but not for such a formal occasion, surely? Closer inspection will reveal that Hugh's left foot is neatly encased in plaster. He's broken his leg, all together now – aahhh!! (You didn't expect sympathy from this mob did you, Hugh?). What happened, then, or is it too embarrassing to mention? Perhaps you hadn't heard of the motto of an American motor-racing team manager, so well known that his name escapes me, whose team were in financial difficulties, which went: "Always check his back pocket before kicking his butt!" I think he meant: "Don't bite the hand that feeds you" but it seemed more appropriate and apt in your case. The 'again' bit in the sub-heading is because the Editor vaguely recalls your being in a similar predicament a few years ago. True or false? Mind you, his mind is going a bit you know so he could be mistaken. Get well soon, Hugh, and take up something safe like knitting – the needles will come in handy when the leg starts to itch.*

One shoe Hugh, the south-paw swinger of the Southern Branch.

Photo: Oliver Statham.

Editor's note

It gives me pleasure to introduce a new Panel Member, tinged with sadness at the loss of a former contributor. Welcome to Tony Chestney (photo) and my thanks to Tony for stepping into the 'breach'.

Tony Chestney, the new man looking for YOUR news.

Off to 'pastures new' is John Hall after several fruitful years as your News of Members correspondent (see Silsoe Link article). John is the epitome (and I spelt it right this time!) of the metaphorical beaver – working quietly but thoroughly behind the scenes, a reassuring figure to have on one's Panel. His wit may not have been to everyone's taste but neither was Shakespeare's at the time. That said, it raised many, many more chuckles than groans and that, in my opinion, is what good writing is all about. Thank you, John.

And now – what are YOU doing these days? It may seem mundane, you may think that no-one would be interested, but you'd be wrong. Let Tony know, a few lines is all it takes to make him a happier man! His address is: 32 Beverley Crescent, Bedford MK40 4BY. Go on, make his day!

Lost Members

I give below a list of members and their last known addresses, with whom we seem to have lost contact. If any member knows their whereabouts would they please contact the Secretariat.

P. C. Devillez, PO Box 784, Harare, Zimbabwe.

J. R. Downes, Vicon Espana S.A., Avda. de Cuba s/n, Palacia, Spain.

J. Nicholson, 20 Eastfield Road, Westbury on Trym, Bristol.

C. T. Nyongo, PAFSAT/NWP PO Box 558, Bamenda, North West Province, Cameroon.

K. Rhodes, Three Sides Farm Rte 3, PO Box 299, De Kalb, Texas 75559, USA.

C. L. Swan, 1 Sciennes House Place, Edinburgh.

D. M. E. Thompson, 107 Ampthill Road, Maulden, Bedford MK45 2EF.

outgoings from repayment of loans for facility construction, tax, rates, staff wages, insurance, administrative costs and machinery and plant purchase and depreciation.

Land capability

Theoretically, golf courses can be built on any land type. However sites which are naturally free-draining with broad-scale undulations provide the ideal base material. Careful preselection of site therefore avoids the need for excessive expenditure on earthworks and the requirement for intensive fairway drainage systems.

Availability of local sources of specified sands and gravels for construction is also crucial. Choice of the correct construction materials, ie those conforming to exacting specifications formulated on sound scientific principles, is critical to the effectiveness of the construction design. For example, in the case of sand for green root-zone formation, factors to be assessed prior to selection include:

- actual particle size;
- uniformity of particle size distribution;
- physical stability of the individual grains;
- chemical composition of the material.

Construction consultancy work by Greens of Scotland has highlighted a lack of suitable sands and gravels screened to specification in the Grampian area. This is not a reflection of an availability problem but rather a lack of awareness in quarry producers as to the importance of such specification in sports construction. Large quantities of sands and gravels are used in course construction, for example some 5,000 tonnes of sand would be required for root-zone formation on greens on an average-size construction project.

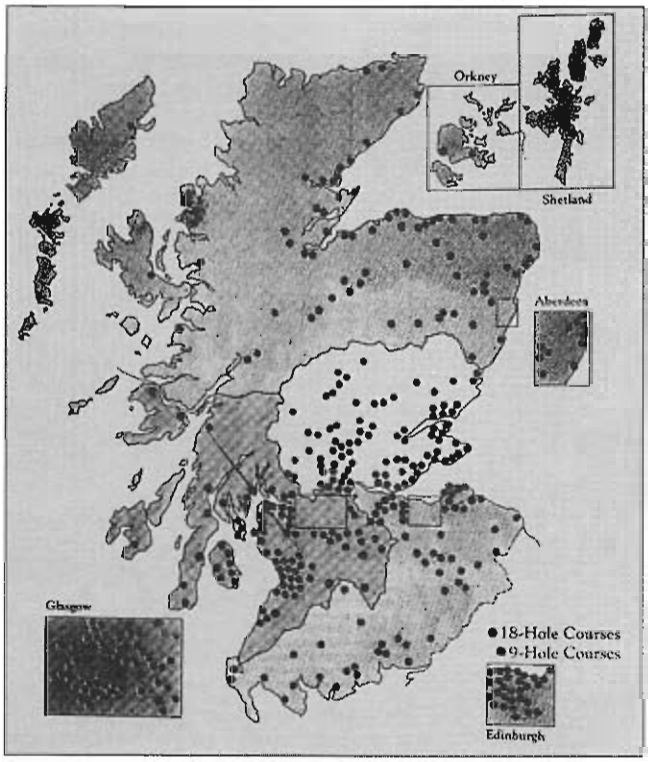


Fig 2. Scottish golf course distribution (Price, 1990).

Available site access, requirement for fairway destoning, irrigation, tree planting and availability of electricity and sewage services are all factors considered in the compilation of a land capability study. Approximate project costings can then be provided.

Construction costing carried out on the basis of such capability studies recently has shown that capital investment will on average fall within the range £500,000 to £800,000 per course. This figure is exclusive of clubhouse construction costs.

Rationale of design

The key to successful course design is to exhibit an empathy with the aspect and contouring of the site prior to formulation of a course layout plan.

Designer trends in the late sixties and early seventies favoured major earthworks and landscaping to produce a highly contoured effect (Fig 4). Financial considerations increasingly rule this approach prohibitive on most projects. Generally speaking therefore a course should use the natural contours of the site. Further to this, eight basic rules apply (Hawtree, 1983 – *see panel above*).

Golf course design
The 8 basic rules

- Two loops of nine holes entered on a club-house.
- Short distances between greens and the following tees.
- Avoidance of long steep ascents.
- Adequate green and tee area to cope with predicted number of rounds per annum.
- Variety in distribution and length of shot.
- Judicious positioning of bunkers and water hazards to afford player interest.
- Use where appropriate of trees for aesthetic enhancement of the site.
- Layout to favour good maintenance access and facilitate mowing management.

CAD design

The recent acquisition by Greens of Scotland of the latest surveying and computer aided draughting (CAD) equipment has proved a real boon for field recording and course design. With these facilities, jobs which previously took weeks to process can now be completed in days or in some cases hours. This means a major saving in terms of consultancy man-power so that these services are on offer at a very competitive rate. Associated software programs offer a range of options for both designers and client. Detailed plans can be prepared at any requested scale showing existing topographic features of the site along with the proposed completed design.

The most useful aspect of these facilities, however, is the ability to prepare a three-dimensional view of the completed project. This is available with a walk-through facility so the client can actually see how the finished project will appear before any machinery is committed to the site. Similarly, design modifications can be quickly made and viewed to ensure clients needs are completely satisfied. Where major earthworks are contemplated the same suite of programs will also calculate the volumes of cut and fill so that project costs can be accurately estimated.

Quite apart from refining the actual design process to avoid unnecessary earth moving, the above facilities also allow the environ-

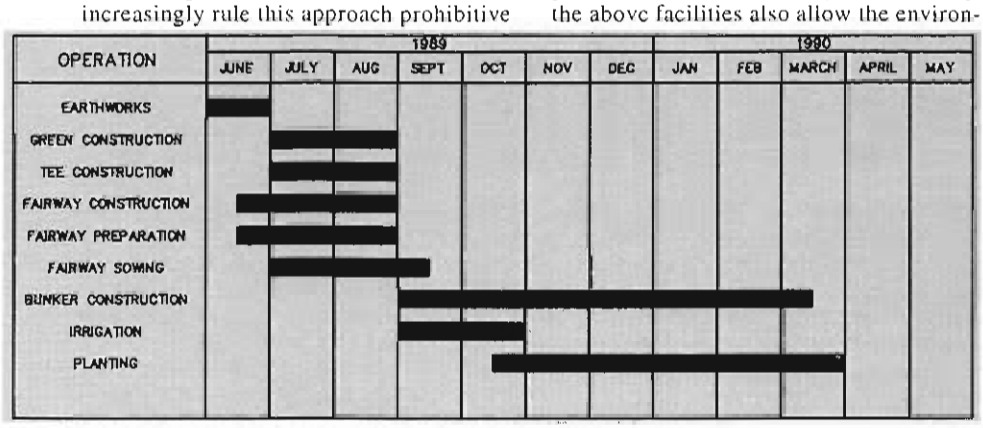


Fig 3. Project scheduling ensures minimal damage to soil structure.

Fig 4. Landscaping to produce a highly contoured effect.

mental impact of the proposed project to be properly assessed, helping to meet the requirements of all interested parties.

Project scheduling and site supervision

Ensuring the construction contractor fully understands the course design and that he carries out the work as specified also falls into the consultant's remit.

Recent Greens of Scotland construction schedules are based on the completion of the course over a two-year cycle. A typical schedule (Fig 3) allows for major earthworks, green and tee construction and destoning to be carried out at a time when minimal damage will be inflicted on soil structure. All too frequently, unsupervised projects see major earthworks carried out using heavy plant in wet soil conditions resulting in avoidable induced drainage problems.

Similarly, when it comes to establishment of the turf, contractors often fail to appreciate the basic requirements for achieving good germination and establishment. It is not uncommon to see expensive seed mixtures, selected on the basis of compactness, fineness of leaf, tolerance of close mowing, wear tolerance and winter greenness failing to establish as a result of poor seed-bed preparation or fertility imbalances. Also a disregard for the local climate and specialist drainage requirements for sports turf sometimes leads to turf being sown out with the growing season on wet seed-beds, with inevitably disappointing results.

It is in these areas that consultants in drainage and agronomy prove invaluable, ensuring contractors are aware of the pitfalls in establishment and advising on their avoidance.

The role of the turf agronomist

In general terms the role of the consultant agronomist on the established course is to maintain turf cover for play and more specifically to maintain cover of sown species.

Typically, golf greens are sown with a mixture comprising of 80% Chewings fescue and 20% browntop bent *(Agrostis castellana)*. The two species blend well together to form compact turf with a high shoot density of uniform texture and both are tolerant of low-pH soils, low fertility and close mowing. Misguided green management however tends to favour the ingression of annual meadowgrass *(Poa annua)* into the turf. This species is undesirable in fine turf largely due to its tufted growth habit which affects the smoothness of the playing surface. In addition the species tends to have poor drought tolerance, poor winter colour and has a high susceptibility to Fusarium *(Microdochium nivale)* attack.

It is possible to achieve turf free of *Poa annua* through the use of herbicide applications to aminotriazole resistant varieties of Chewings fescue and browntop bent *(Agrostis tenuis)* thereby eliminating weed grasses (Johnston and McBride, 1989), but cultural control using an integrated management system is still the norm.

The consultant agronomist must assess the factors resulting in annual meadowgrass ingression. It is known for example that *Poa annua* survives better than the bents and fescues in the compacted soil conditions commonly encountered on heavily used greens. This is due to the tendency for the plant to form a shallow root system under these conditions. Regular aeration through tining, therefore, is an essential management practice in order to maintain the competitive edge of the bent/fescue turf. Further manage-ment policies or *Poa* eradication are based on the ability of bents and fescue to survive under more stressful conditions of high acidity, low fertility and drought. Over-watering, excessive fertiliser application and liming of fine turf is to be avoided, therefore.

Concluding remarks

There can be no doubt that the popularity of the game of golf is set to rise throughout the next decade. The design, planning and con-struction of new facilities required to meet the demand will require technical input from a diverse range of specialists. The technical expertise available within Greens of Scotland is easily applied to golf course consultancy.

Looking to the future there will be further demand on the skills of our architectural services for the design of club-houses and greenkeeper accommodation and for the expertise of Greens of Scotland's conservation and environmental consultants as the golfing public come to realise the habitat potential of their course.

The skills developed in Scotland are increasingly likely to be used on courses further afield as France, Germany, Holland and Portugal also attempt to keep pace with a growing demand for a limited commodity.

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Farm tractor distribution and utilisation in Benue and Plateau States, Nigeria

D O Aneke and G B Ayoola

The authors describe the nature and magnitude of the farm power problems in Benue and Plateau States.

A survey of tractor distribution and utilisation has also gathered information on the relative performance of different makes of tractor and with this data there is now an empirical basis on which to take major decisions for any tractor rehabilitation and management programme in these States. Location of maintenance workshops, purchase of spare parts, training of technical personnel can now be better determined.

Following devaluation of the Naira, the unit prices of farm machinery have multiplied many-fold. In consequence, a programme of rehabilitation and efficient management of the existing tractor stock is likely to be more cost effective than the purchase of new tractors.

Survey needed to provide basic data

However, there is the problem of inadequate knowledge of the conditions of the available tractors to properly assess the need for rehabilitation and management. Data are not available to determine either the status of such on-farm tractors and machinery stock or their distribution and efficiency. There was, therefore, a need to carry out a field survey to identify the tractors and evaluate their present conditions and the requirements for enhancing their efficiency.

Objectives of the survey

The ultimate goal of this project has been to determine the relative importance of farm mechanisation problems in different areas of the country and to provide guidelines for efficient allocation of resources to tractor and farm machinery rehabilitation programmes.

The specific objectives have been:

(i) to determine the spatial distributions of tractors by make, types, ownership and use;

(ii) to describe the present conditions of the tractors with a view to determining the degree of farm power problems;

(iii) to make recommendations about the general and specific roles of the government and individuals in providing support to rehabilitate tractors all over the country, and

(iv) to provide information on the field performances of various makes of tractors in Nigeria to their overseas manufacturers.

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Methodology

Questionnaires were developed and distributed to collect the necessary data. The questionnaires were of two types.

Type 1 questionnaires sought general information, including location of tractors and implements, their ownership pattern and management system, repairs and maintenance facilities available as well as spare parts. Type 2 questionnaires sought information about tractor's identification number, types, make, condition and problems.

The method used to collect the information was through collaboration with the Agricultural Development Projects (ADP) in the States. In particular the Agricultural Extension System of the ADP was used to reach farmers in their areas of operation. A typical ADP has extension workers in each zone of the State. A zone is divided into 'areas' and an area is divided into 'blocks'.

The corresponding sequence of extension personnel are the Zonal Extension Officer (ZEO), Area Extension Officer (AEO) and Block Extension Supervisors (BES). At the grassroot level, there are village extension agents (VEAs) who have primary contact with the farming households. A zone has a number of 'Subject Matter Specialists' (SMSs) who have linkage with the Zonal Extension Officers especially through the monthly technology review meetings (MTRMs) and fortnightly training (FNT) programmes.

The Village Extension Agents (VEAs) were used in this survey as enumerators for the purpose of collecting data in the field. They were duly trained in the proper administration of the questionnaires by the SMSs and AEOs who had earlier been trained by the investigators who are also leaders of this project. The SMSs and AEOs were reached collectively at the MTRM during which they were also trained for this survey. With the co-operation of the ZEOs the retrieval of the questionnaires was very easy and successful.

Table 1. Distribution of tractors by make and type.

Make	*No. of tractors*		*Crawler*		*2-wheel drive*		*4-wheel drive*	
	Benue State	*Plateau State*						
	B/S	*P/S*	*B/S*	*P/S*	*B/S*	*P/S*	*B/S*	*P/S*
Ford	18	47	0	0	4	2	14	45
Steyr	97	93	0	0	21	14	76	79
Fiat	36	44	0	0	12	3	24	41
Massey Ferguson	136	12	0	0	26	3	110	9
John Deere	7	5	0	0	2	–	5	5
David Brown	36	–	0	0	13	–	23	–
Others	2	6	0	0	–	–	2	6
Total	332	207	–	–	78	22	254	185

Data collection and processing

The enumerators (VEA) collected the data on tractor ownership and population from all the local government area of the State. The knowledge of the grassroot situation by the VEAs was found useful in identifying and easily locating tractor owners in every nook and corner of the States. Effective coverage was achieved through the supervision of the enumerators by the BES. The SMSs and

Table 2. Condition of tractors (numbers serviceable/unserviceable).

Make	*Serviceable*		*Unserviceable*	
	B/S	*P/S*	*B/S*	*P/S*
Ford	14	30	4	17
Steyr	64	47	33	46
Fiat	30	26	6	18
Massey F.	81	7	55	5
John Deere	2	3	5	2
David Brown	33	–	3	–
Others	–	–	2	6
Total	224	113	108	94

Table 3. Selected general features of tractors sampled.

Feature	*Benue State*	*Plateau State*
Ownership		
Private	4	6
Federal Government	80	89
State Government	11	2
Local Government	52	10
Co-operatives	86	100
Total	332	207
Mean age (years)	7.65 yrs	6.23 yrs
Mode of acquisition		
Direct purchase	184	144
Leasing	0	0
Purchased second-hand	54	41
Others	94	22
Workshops used		
Goverment	18	32
Private	220	274
Spare Parts (availability)		
Easily available	12	33
Available with difficulty	216	164
Not available	10	10
Spare Parts (source)		
Goverment service centres	68	32
Company	69	52
Local dealer	101	103
Operation		
Farming	219	180
Forestry	1	–
Transportation	18	27

AEOs guided the BES at every stage of the enumerators' work. Overall supervision was carried out by the leaders of this project and their central support staff.

The data was coded into forms suitable for computer analysis; that is a combination of the LOTUS and the STAFFAST statistical packages. The quality of the set of data available for use in the final analysis and report was high.

Results and discussions

General features of importance, apart from tractor distribution, are the pattern of ownership, age, mode of acquisition, workshop and spare parts facilities as well as the operations for which tractors are used (Table 3).

Table 3 shows that the greatest number of tractors are owned by the co-operatives, followed by the Federal Government. The tractors are fairly old, with mean after-purchase ages of 6 to 8 years.

The general mode of acquisition of tractors is by direct purchase. A good number of them were also acquired through second-hand sales. Acquisition by lease arrangement was not observed.

From Table 1 it is observed that Massey Ferguson tractors are dominant in Benue State, followed by Steyr tractors. In Plateau State, Steyr tractors are more prevalent than all the other makes of tractors. Massey Ferguson tractors were the first to be introduced in Benue State so consequently Massey Ferguson tractors are now used extensively throughout the State. Nigeria assembles Steyr tractors and therefore encouraged their use by Nigerian farmers. This accounts for the extensive use of Steyr tractors in both States.

Four-wheel drive tractors are generally used for farming operations and are therefore dominant over all other types (Table 1).

The high number of unserviceable tractors (Table 2) is partly due to unavailability of spare parts, negative attitude of tractor owners and operators to the maintenance culture and lack of funds. Tractor repairs are mainly carried out by private workshops. Spare parts are most frequently sourced from local dealers and are generally available only with difficulty.

The tractors are mostly used to perform farming operations and transportation of goods within short distances. There is little use of tractors for forestry activities.

The foregoing observations have important relevance to the programme of rehabilitation especially in terms of ownership, spare parts, age and service centres. Private owners (co-operatives) would benefit immensely from rehabilitation programmes as they own the bulk of tractors which are old and for which spare parts are generally unavailable.

Table 2 indicates 37.5% of tractors are unserviceable. Table 6 shows that most of the engines are either malfunctioning or completely broken down. Numerous other operational faults were reported in all makes of tractor. In fact over 80% of tractors on the surveys required repair.

This set of information could be employed in planning a tractor rehabilitation programme in the States as well as in undertaking cost-effective procurement of spare parts.

Table 5 shows relative causes of tractor breakdown which includes availability of spare parts, transportation damage, manufacturers' and operators' faults, environmental damage and poor maintenance.

Lack of spare parts was found to be the commonest problem in all the States. This suggests that a substantial part of a rehabilitation fund would be spent on spare parts. Poor maintenance is also another important factor. This could mean that the capabilities of the available technical maintenance personnel is in question or that the maintenance of tractors by owners is insufficient. In either case, a sound maintenance culture is called for.

From the data in Table 7 it can be seen that many malfunctioning or broken down tractors are not even under repair. Servicing intervals can be as high as over 200 hours (Table 4).

Conclusions

The results of the survey of farm tractor distribution and utilisation in Benue and Plateau States are interesting and revealing. These revelations lead to the following conclusions:

- There is a need for a definite and systematic rehabilitation programme of tractors in these States. This is evidenced by the large number of tractors in poor

Table 4. Frequency of servicing – Benue State.

Make	*No. Tractors*	*Mean hours use before service*
Ford	18	189
Steyr	97	192
Fiat	36	133
Massey F.	136	212.
John Deere	7	70
David Brown	36	85

Table 5. Causes of tractor breakdown by make (frequency of causes).

Make	*No. of Tractors*		*Lack of spare parts*		*Transportation damage*		*Manufacturer's fault*		*Technical (Operator's fault)*		*Environmental (Weather)*		*Poor Maintenance*	
	BS	*PS*	*BS*	*PS*	*BS*	*PS*	*BS*	*PS*	*BS*	*PS*	*BS*	*PS*	*BS*	*PS*
Ford	18	47	6	20	–	4	–	4	4	8	1	4	2	9
Steyr	97	93	49	4	15	12	16	11	11	18	8	9	55	29
Fiat	36	44	16	33	2	11	–	11	–	11	4	1	7	10
Massey F.	136	12	78	29	20	4	22	1	8	3	18	4	64	7
John Deere	7	5	4	6	–	1	–	1	–	4	3	1	6	4
David Brown	36	–	22	4	–	1	–	1	–	–	–	–	19	2
Others	2	6	–	5	–	–	–	–	–	–	–	–	–	–

Table 6. Prevalence of systems breakdown by make of tractors.

Make	No. of Tractors		Lubrication		Engine		Fuel		Cooling		Electrical		Transmission		Brakes		Drawbar	
	BS	PS	BS	PS	BS	PS	BS	PS	BS	PS	BS	PS	BS	PS	BS	PS	BS	PS
Ford	18	47	6	21	3	22	6	23	3	20	5	18	4	18	6	17	5	18
Steyr	97	93	16	23	35	25	16	33	19	33	12	24	14	23	22	33	16	22
Fiat	36	44	12	21	6	23	11	22	3	20	7	22	6	22	5	2	4	23
Massey F.	136	12	17	6	85	8	13	6	21	7	53	7	22	6	37	6	36	3
John Deere	7	5	5	4	6	4	3	4	5	4	6	2	–	4	1	4	7	4
David Brown	36	–	9	–	23	–	7	–	10	–	14	–	15	–	20	–	22	–

mechanical conditions.

- There is also the need for further study of the reliability of different makes of tractors in the States to determine the most reliable and cost-effective makes.
- Lack of parts and poor tractor maintenance have been found to be the major causes of tractor breakdown in the States.
- Generally, the breakdowns due to malfunctioning of tractor systems appear to be evenly distributed across the systems, with the highest frequencies in the lubrication, engine and drawbar systems.
- Despite the fact that nearly all the broken down tractors can still be economically repaired it is clear that the attitude to repair of tractors in these States is very poor. This is evidenced by the fact that the tractors were usually over-used before services are carried out.

Table 8. Reasons for negative attitude in maintenance of tractors by make.

Make	No. of tractors		Unavailability of spare part		Spare parts costly		Lack of funds		Uneconomical		Intention to replace	
	BS	PS	BS	PS	BS	PS	BS	PS	BS	PS	BS	PS
Ford	18	47	11	4	15	–	4	1	–	–	21	–
Steyr	97	93	–	8	11	14	7	2	–	–	43	–
Fiat	36	44	21	1	24	8	11	6	–	–	–	–
Massey F.	136	12	47	5	36	9	21	8	–	–	–	–
John Deere	7	5	–	–	2	–	–	–	1	–	–	–
David Brown	36	–	20	–	–	–	14	–	–	–	24	–

It is therefore recommended that:

1) the training of farmers in servicing and maintenance of tractors be improved;
2) a programme of servicing and maintenance of tractors operated by Government and Corporate Agencies is considered;
3) the supply and distribution of spare parts is given urgent attention.

Finally, it is hoped that the information provided on the field performances of the various makes of tractors in Nigeria will assist the manufacturers in finding answers and solutions to the observed weaknesses of the various tractors and hence improve the reliability of tractors operated in a Nigerian environment.

Table 7. Attitude toward repair of tractors (frequency).

Make	No. of broken down tractors		Under repair		Not under repair	
	BS	PS	BS	PS	BS	PS
Ford	8	27	2	22	6	5
Steyr	65	29	21	13	44	16
Fiat	21	14	13	6	8	8
Int. Harv.	–	31	–	17	–	14
Massey F.	33	3	30	3	–	–
John Deere	2	–	–	1	2	–
David Brown	22	–	7	–	15	–

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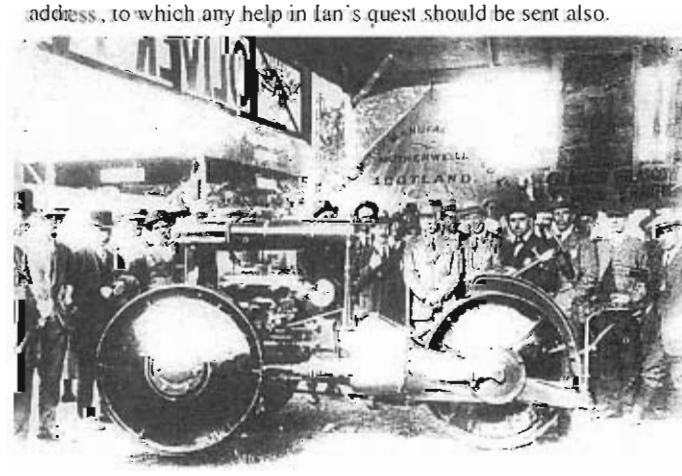
Sleeve valve research – *can you help?*

An interest in Scotland's only native tractor, the Glasgow, has led **Ian Fleming** into the search for the origins of the sleeve valve. The Glasgow was produced by John Wallace & Sons, the first model appearing in 1919. It was heralded as a major advance in tractor technology with many novel features that set it apart from and above its contemporaries.

John Wallace is believed to have bought the patent rights for the sleeve valve engine in the early 1900s but only made a small sleeve valve stationary engine for farm use. It would appear though, that he granted rights to other Clydeside firms to manufacture sleeve valve engines for other uses. Ian believes that the sleeve valve engine was first developed by Peter Burt but is the first to admit that there are a lot of gaps in this particular trail. Can any members help piece together this historical jigsaw and, through coincidence, add to the John Wallace story?

Ian is Joint Hon Secretary with Gavin Sprott of the Scottish Country Life Museums Trust, part of the National Museums of Scotland based at Queen Street, Edinburgh EH2 1JD. That organisation has, after a long search, taken delivery of a Glasgow tractor – one of only four or five in existence. To complement this achievement there is an illustrated booklet written by David Brown describing the short history of this significant machine. It is available from the above address, to which any help in Ian's quest should be sent also.



The innovative Glasgow tractor photographed at its launch in 1919. "An unusual and effective design doomed by its exorbitant cost".

The potential of cellulosic crops for UK agriculture

The long-term nature of conventional forestry puts a severe strain on financial resources. A variation to conventional forestry systems, and one which warrants further examination is the coppicing of species such as *Salix* (willow), and *Alnus* (poplar) which produce biomass very rapidly. Surplus cereal straw and other agricultural crop residues are another potential source of cellulose but, although the initial costs are low, transport and handling costs are likely to be high.

Ivan Warboys and Tony Houghtou here review market prospects and focus attention on the potential of other non-woody fibrous plants that could yield higher levels of cellulose.

The rapid rise of agricultural productivity in Western Europe has generated large food surpluses and the industry now needs new crop products and markets. The production of non-food crops for industrial use (eg pharmaceuticals, bioethanol production, fibres) is of increasing interest. Forestry, the major source of pulping fibres, is frequently quoted as a potential alternative enterprise. However, the very long-term nature of conventional forestry puts a severe strain on the financial resources of the farmer. Other crops warrant attention.

The world fibres market

In order to understand the potential for industrial use of non-woody fibre crops, it is necessary to examine the international market for fibre products. The world market for products manufactured from cellulose fibres can be divided into:

- pulp;
- paper and board;
- textiles and
- hard fibres.

World pulp is largely supplied by North America (45%) and Western Europe (28%) with Eastern Europe supplying less than 10%, mostly from the USSR.

World pulp production grew rapidly between 1985 to 1989 at an annual rate of 4% due to the consumption of paper and board. In 1990 with the world recession it fell by 2.8% as manufacturing plants went on short time and the opening of new facilities was postponed. The anticipated increase in demand for paper products by Eastern Europe as the result of liberalisation has yet to have an effect on the world market.

The world cellulosic pulp market is supplied from two principal sources, wood pulp (95%) and non wood pulp (5%), such as straw, bamboo, or bagasse. Wood pulp is the main raw material for paper and board manufacture.

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In 1990, 93% of the world supply of wood pulp was chemically produced (Sutton & O'Brien, 1991) 85% being made by the kraft process which produces the highest quality pulp for paper making. However, mechanical pulp is increasing its share of the market particularly chemical thermomechanical pulp (CTMP) which also can give higher yields of pulp with less pollution.

The reasons for these changes are largely the result of environmental pressures and pollution worries. Thus there is increasing demand for chlorine-free papers and for recycling waste paper.

The use of waste paper is forecast to increase worldwide from 49 to 84 million tonnes between 1984 and 1995. In 1988 recovery rates of waste paper were approximately 30% in both the US and the UK whereas in Japan and other EC countries recovery rates were around 50%. In the USA the target is 40% by 1995. Already waste paper consumption in the UK is high, representing 53% of the total furnish used in paper and board production (Anon, 1992) with at present the majority of recycled paper pulp used in the manufacture of lower quality paperboard. By the year 2000 it is

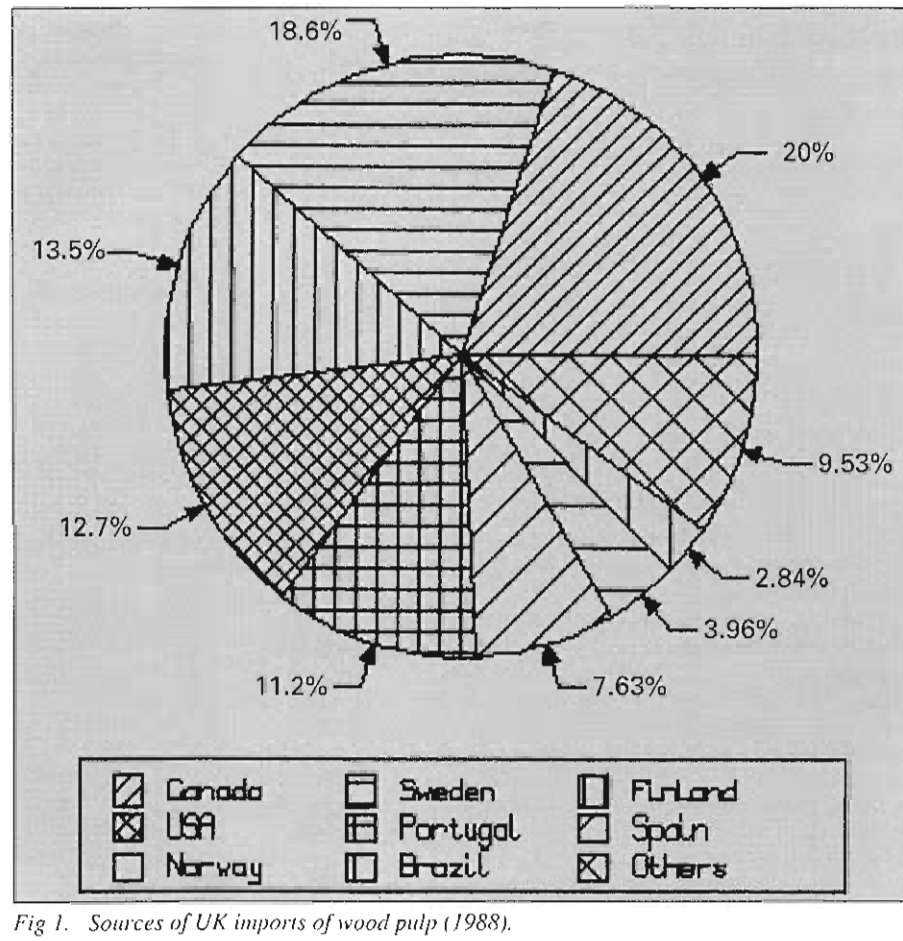

Fig 1. Sources of UK imports of wood pulp (1988).

suggested that improved deinking technology will result in the majority of recycled paper pulp being used in the production of so called 'virgin' grades.

The UK pulp market

There are two distinguishing features of the UK pulp market. Firstly, the total demand for pulp has been rising (up to 1989) primarily due to the increase in demand for paper and board but has now fallen back with the recession. Secondly, almost all of the pulp utilised is derived from imported wood pulp since the UK is the least wooded in Europe with less than 10% of its land area forested. Sources of UK imports are shown in Fig 1. This shows that North America and Scandinavia together supply about 66% of the UK requirement with a further 19% coming from eucalyptus sources in Spain and Portugal.

Paper and board

In the UK the demand for paper and board, in line with world trends, rose by approximately 24% between 1986 and 1989 (Fig 2). The bulk of supplies to meet this rising demand comes from imports as the UK's level of self sufficiency in paper and board amounted in 1989 to only 46%. Since 1989 demand has fallen by 8%. However, further analysis of this market is necessary to enable the potential for non-woody fibres to be assessed.

– printing and writing paper

The printing and writing paper segment constitutes the largest part of the paper and board sector and accounts for approximately 38% of total paper and board consumption in both the EEC and UK (Fig 3). Within this market segment 65% of output in Western Europe is used in advertising, 20% is used for office stationery and the remainder is divided between a variety of uses such as books and writing paper.

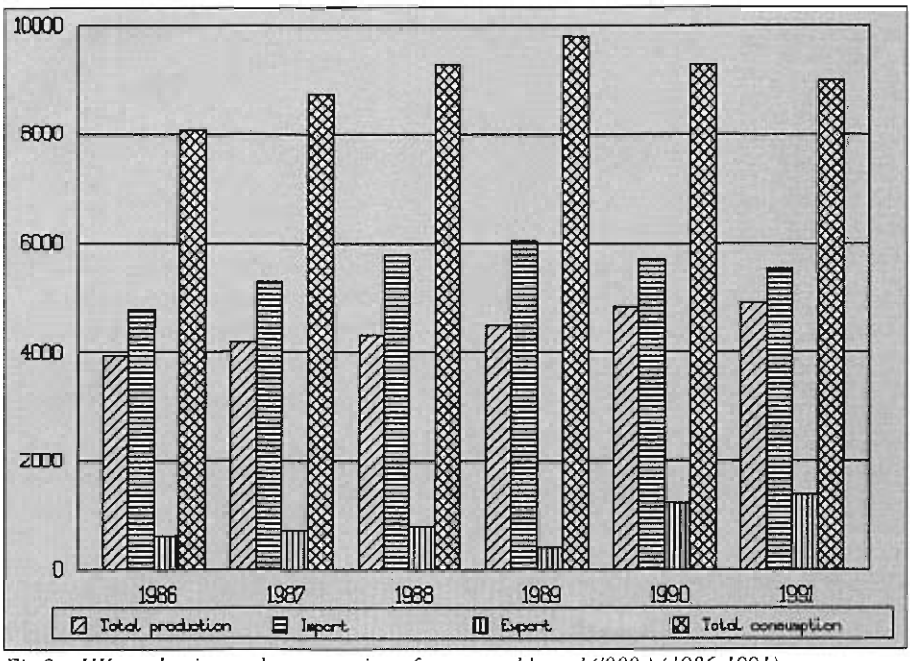

Fig 2. UK production and consumption of paper and board ('000t) (1986-1991).

In 1985 only 46% of the UK consumption of printing and writing paper (2.2 million tonnes) was domestically produced. The majority of UK (and EEC) demand was satisfied by imports from the Scandinavian countries which are also the world's major exporters. Europe as a whole exports 13% of its production of printing and writing paper.

In the advertising industry – the largest user – competition from television has led to a change in emphasis of printed advertising material away from mass circulation to specifically targeted, specialist use. The demand for printing and writing paper by the advertising industry is now far more specialised and requires short production runs of very high quality paper rather than mass production of printed material.

Printing and writing paper in the office now accounts for 20% of worldwide consumption. This demand is greatly affected by rapid changes in office technology and the use of computer systems. Nevertheless the office is still likely to remain a significant user of printing and writing paper in the foreseeable future.

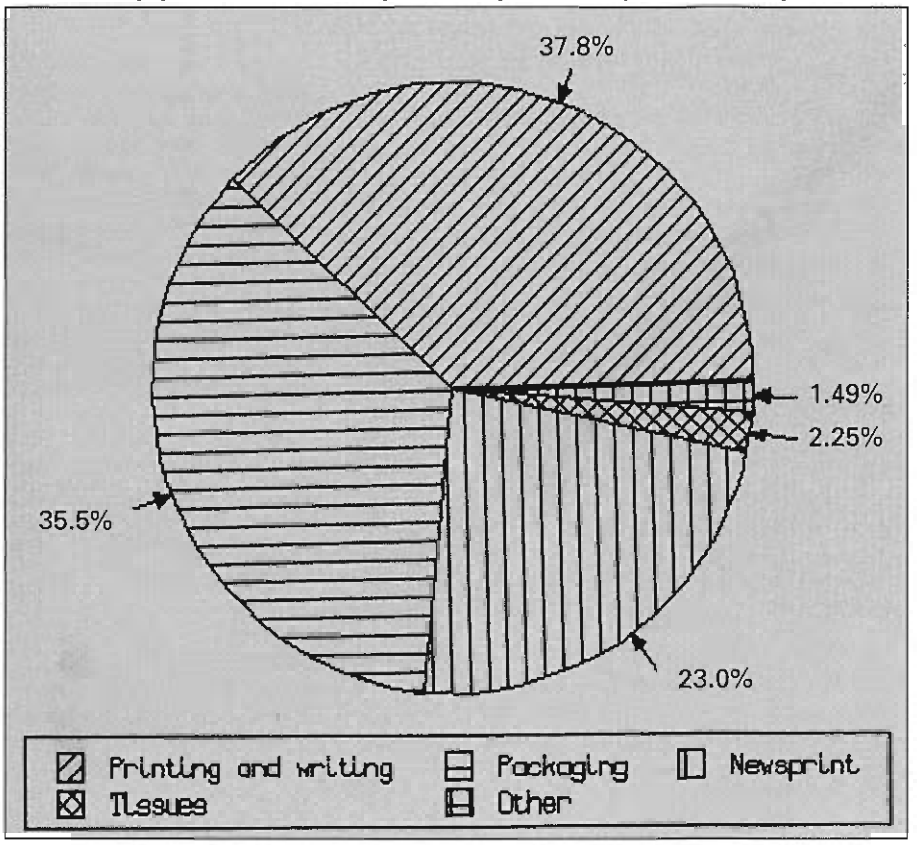

Fig 3. UK paper and board market sectors (1989).

– packaging

Packaging accounts for approximately 36% of the total market for paper and board in the UK (Fig 3), the main component of which is 'Kraftliner'. The Western Europe requirement of 2.3 million tonnes in 1985 was largely supplied by imports (2 million tonnes), with the USA being the main source of supply. The EEC in general and the UK in particular have very low levels of domestic production of packaging material in relation to overall demand.

– newsprint

This segment of the market accounts for approximately 23% of the UK consumption of paper and board (Fig 3). However, the EEC is approximately 53% self sufficient compared with a self sufficiency of 23% (1.5 million tonnes) for the UK. The main source of supplies of newsprint for the UK and EEC markets is Scandinavia.

Newsprint is used mainly for the manufacture of newspapers but is also used for

making printing and writing paper in some developing countries. The pulp used in its manufacture is mainly composed of mechanical rather than chemical wood pulp since high quality is not as important for the production of newsprint as for printing and writing paper. The majority of recycled paper currently utilised is also channelled into the manufacture of newsprint.

Potential fibre crops

Historically non-woody species such as Esparto grass were the main source of cellulosic fibres for pulp, textiles and cordage. For the pulper the porous structure of annual crops provides for easier penetration by the chemicals which are used today. They also have lower lignin and higher hemicellulose contents than most woods and show a rapid response to refining. The could, at least, provide a supplementary source of pulp for blending with wood pulps.

A list of non-woody species is shown in Table 1. The list includes all those genera which had or still have commercial value. Some of the monocotyledonous crops are semi-tropical and may only suit the Mediterranean countries of Europe and not the cool temperate zone of the UK.

Within this list are plants such as Sisal, Abaca, Cotton, Ramie, Flax, Hemp, Jute and Esparto grass which have provided the traditional sources of fibre. Of these only Ramie, Flax and Hemp are hardy and can be grown under temperate conditions.

Table 1. Non-woody cellulosic crops.

	Monocotyledons	
Agavaceae	Sisal	*Agave sisalana*
Gramineae	Sudan grass	*Sorghum arundinaceum*
	Columbus grass	*Sorghum almum*
	Sorghum	*Sorghum bicolor*
	Indian grass	*Sorgastrum nutans*
	Johnson grass	*Sorghum halapense*
	Maize	*Zea mays*
	Bulrush millet	*Pennisetum typhoides*
	Common reed	*Arundo donax*
	Giant reed	*Phragmites communis*
	Bamboo	*Arundinaria japonica*
		Bambus vulgaris
		Phyllostachys pubescens
		Sassa palmata
		Dendrocalamus strictus
	Alfa	*Stipa tenacissima*
	Esparto grass	*Lygeum spartum*
Musaceae	Abaca	*Musa textilis*
	Eulalia grass	*Miscanthus sinensis*
	Elephant grass	*Miscanthus gigantheum*
	Sabai grass	*Eulaliopsis binata*
	Uva grass	*Gynerium sagittatum*
	Dicotyledons	
Liliaceae	New Zealand flax	*Phormium tenax*
	Yucca	*Yucca filamentosa*
Malvaceae	Cotton	*Gossypium* sp
	Kenaf	*Hibiscus cannabis*
	Roselle	*Hibiscus subdariffa*
	China jute	*Abutilon avicennae*
	Aramima	*Urena lobata*
Urticaceae	Ramie	*Boehmeria nivea*
	Nettle	*Urtica dioica*
Leguminosae	Sunn hemp	*Crotalaria junceum*
	Spanish broom	*Spartium junceum*
Linaceae	Flax	*Linum usitatissimum*
Cannabidaceae	Hemp	*Cannabis sativa*
Tiliaceae	Jute	*Corchorus* sp
	Sparman	*Sparmannia africana*

Despite the very extensive number of grasses, only one, Esparto grass, has ever been commercially exploited and traded in Europe. Outside Europe Bamboo is commercially important in Asia and China but not on a world scale. This is surprising since the grass family is so widespread throughout the world both in temperate and tropical situations. Many of them are perennials and incur no annual establishment costs once planted.

Agro-ecological constraints

For the successful cultivation of annual (or perennial) non-woody fibre crops in the UK, potential crops should be able to survive a cool spring (or winter) and produce their maximum dry matter of stem to mature by mid-September. This gives a growth period of around 120 days. The extensive breeding programmes with **Kenaf** in North America now enable the crop to be grown throughout the USA. However, threshold temperatures for germination and establishment would need to be determined before the crop could be grown in the UK.

Flax is now widely cultivated in Northern Europe including the UK largely for its oil seed. Its use for linen in Ireland and Belgium has declined because of high production and processing costs as well as the strong competition from synthetic fibres, whilst the recent interest in flax production in Scotland apparently foundered because of the lack of a commercial backer for a processing mill. But the agro-ecological conditions remain favourable for its cultivation.

With flax only 13% of the stem, the bast fibres, are used for textiles. If the short woody fibres (tow) were used a further 16% would be added to the fibre yield. A further 40% is lost as shive in the scutching process. Thus the whole crop potential of flax needs to be examined, multi-branch long stem varieties selected and agronomic practices identified which can maximise fibre yield per hectare.

Hemp also suits temperate climates but has not been grown in the UK for over 200 years in any quantity. The potential for growing the crop and pulping whole stems using French monoecious varieties is being investigated in Holland. Nevertheless the major constraint to its widespread adoption must be the lack of resinous-free varieties.

Of the perennials, the **Bamboo** family with its vast source of unexploited species, its world-wide use as a source of pulp and its ability to grow on a wide range of soils has much to offer.

Although Bamboos are grown in the UK for their canes and for landscaping purposes there have been few trials to test the potential of frost hardy species under UK conditions.

There are two additional constraints to the adoption of Bamboos for large scale cultivation. One is the need to establish agronomic practices which will enable Bamboos to produce uniform growth of culms to enable once-over mechanical harvesting as opposed to selective harvesting by hand. Secondly there is need to select species with a range of flowering cycles to avoid the likelihood of the total source flowering simultaneously.

One winter hardy grass, **Miscanthus**, has been shown from work in Denmark, Germany and Holland to have potential for biomass production but work needs to be done in the UK to establish its potential for fibre production.

Yield potential of selected crops

Table 2 summarises the dry matter yields of potential fibre crops in comparison with short rotation forestry and straw residues. Some of the data is only applicable to tropical environments and hence the range of yields is wide. Nevertheless average yields of the annual crops, Kenaf, Flax and Sorghum, and the perennial Miscanthus are encouraging and compare favourably with short rotation forestry.

Harvesting

Fibre crops, unlike grain crops, are bulky, low density and of low value. For economically viable systems of storing and transportation, comminution and densification are essential since the basic economic consideration will be the cost per tonne dry matter delivered. Transportation costs vary proportionately to the square root of the production area and since land area required for a given target varies inversely with productivity,

economic viability will be enhanced by the use of high yielding fibre crops.

Most modern farming practices for existing annual crops require highly mechanised field harvesting and processing equipment. Minimum transportation of crop by-product is usual; hence straw is left in the field.

Any major increase in the use of straw or fibre crops will require major efforts to collect, handle, transport, store and deliver to the pulping plant at a cost competitive with other pulping materials. Annual fibre crops could be harvested as whole crops with existing forage harvesters such as are used for maize. Some modifications may be necessary to remove unwanted leaves and seeded heads.

Other techniques of cutting then bundling or baling may have fewer storage problems than chopped material but would still at some stage require comminution to increase the density for transport.

Once harvested there would be a need for farm storage either wet as ensilage, or air dried for which on farm processes have yet to be developed. Methods of preservation and storage must be cost effective and therefore the scope for chemical preservatives could be limited.

Table 2. Stem dry matter yields of some non-woody fibre crops in comparison with short rotation forestry and cereal residues.

Crop	*Annual yield (tonnes/ha)*			*Data source*
	average	*range*	*potential*	
Annuals				
Flax	8	6– 9	10	Lockhart (1982)
Hemp	10	9–13	15	De Groot (1988)
Kenaf	10	8–20	40	Kaldor (1990)
Sorghum	9	8–12	30	Sheldrick (1971)
Perennials				
Bamboo *sp*	7	5–12	20	Liese (1985)
Reeds	15	10–20	40	An Estd Espana (1983)
Elephant grass	17	17–25	60	Rijssenbeek (1989)
Short rotation forestry	9	6–15	40	Long Ashton (1988)
Agricultural residues				
Straw	2	1– 3	4	Johnson (1987)
Sunflower stalks				Alcaide (1990)

It is clear that further engineering development work is necessary to increase the density of material to ensure transportation pay loads are economic.

Conclusions

Table 3 summarises the size of the UK cellulose fibre market.

With the cellulosic synthetic fibres and the hard fibre products markets in decline, paper and board is the largest potential market for the future use of cellulosic crops since the market demand has been expanding at a faster rate than any other sector and also because the UK is only 40% self sufficient in paper and board. This reliance of the UK on overseas suppliers for its paper requirements is further emphasised by the fact that 85% of the raw material requirements of domestic paper producers are imported as pulp.

– fibre for pulp production

The market which appears most interesting is fibre for pulp production especially to make printing and writing paper. Firstly the market has been growing and is predicted to grow further. Secondly the UK is in trade deficit (as too are some other countries in Europe) both in terms of pulp and in terms of the finished product (printing and writing paper) thus offering substantial opportunities for import substitution.

In 1990 the UK imported some £3.2bn worth of paper and board plus a further £672m of wood pulp for paper making.

There is also a global environmental issue in that the world's resource of forest timber, the main source of pulp, is not expanding fast enough to meet predicted world demand.

– mixed system of crops

This paper has listed a number of potential candidate crops that could be developed for fibre production. Most of these crops have received little attention, certainly recently, from breeders or agronomists. Without doubt considerable improvements in efficiency could be achieved. However, single crop sourcing for a commercial pulp plant is too risky.

A mixed system with a combination of crops furnishing the raw material topped up with straw as required, could have considerable benefit for spreading harvesting, and reducing risk of crop failure or sudden reduction of supply of the by-product straw caused by changes in financial attractiveness of cereals.

– harvesting and processing

The other critical areas for viability are harvesting technology and pulp processing plants. In both areas considerable advances have been made. The new pulping processes, such as NACO, have transformed the economics of non-woody material pulping.

Table 3. The size of the UK cellulose market (1988).

	Apparent consumption '000 t	*Net imports '000 t*	*Self-sufficiency %*
Pulp	2139	1690	20
Paper and board	9789	6014	40
Cellulosic synthetics	120	4.5	100
Hard fibres products	67	2.5	96

– integrated agro-industrial complex

In our view the yields achieved by potential candidate crops in different locations make an integrated production and pulping agro-industrial complex an attractive proposition.

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Amenity Group forges ahead

The two meetings held in March, one at Thame in Oxfordshire, the other at Newcastle-upon-Tyne, clearly showed the interest in, and gave the support needed for the proposed Specialist Group. As a result the Institution has added the **Amenity and Ecological Engineering Specialist Group** to the list.

The two meetings were organised by the Chairman of the Specialist Groups Panel, John Matthews, and hosted by Kubota (UK) Ltd at Thame and the University of Newcastle-upon-Tyne (Dept of Agricultural and Environmental Science). Both meetings considered the same basic agenda.

Under the agenda item: **Scope of the Topic** a multitude of work areas were mentioned which such a group could service and, logically, it led to a list of meeting topics which will keep the group occupied for many years!

The **Title of the Group** created almost as many suggestions as delegates but in the end Mike Hurst's suggestion was agreed as a good compromise.

When the question of **Types of Events** was put to each meeting there was general agreement that the format and content of meetings must be of an applied nature, of use to practitioners in particular.

The difficulty of electing **Officers and Committee** from the two separate meetings was overcome by carrying forward nominees from Thame to Newcastle. The result:

Brian Hurtley *(Machinery Supply);* David Hicks *(Education);* John Gowing *(Education);* Michael Bird *(Journalism);* Graham Nutt *(Sports Turf Irrigation);* Tony Paine *(Turf Care);* Harry Shipley *(Urban Waste);* Brian James *(ADAS);* Dixie Thompson *(Sports Surfaces).*

Topics for meetings

So what topics will vie for the attention of this new Specialist Group when meetings are being arranged? The suggestions put forward at the two meetings give an indication of the areas of work this group will serve. Here's a few to ponder:

- Land reclamation/reinstatement/ decontamination
- Environmental impact situations
- Irrigation and drainage of amenity areas
- Mechanical collection of surface waste
- Controlled environments
- Enhanced environments
- Cutting and disposing of grass
- Roads and car parks
- 'Vertidrainers' and their engineering
- Recycling
- Urban waste disposal

Members (and non-members) with interests in any of these areas are invited to register with the group. Contact John Gowing, Dept of Agricultural & Environmental Science, University of Newcastle-upon-Tyne, NE1 7RU.

Certified . . .

. . . that ***Geoffrey Tapp*** *has been a member for 25 years. His achievements in those years have been well documented in these pages, not least when he retired as Secretary of our Institution. Suffice to say that they have been 25 distinguished years, well done Geoff. He is pictured receiving his certificate from the Southern Branch Chairman,* ***Rodney Brice-Baker*** *at that Branch's Annual Dinner recently.* *Photo: Oliver Statham.*

Young Agricultural Engineer of the Year

Edward Hutchinson, aged 21, a student at Rycotewood College has won the regional and national finals in Agricultural Engineering to represent England in the World Skills Olympics to be held in Taipei, Taiwan on 24 July – 3 August 1993. The competition is for young trainees up to the age of 22, and is organised by the International Organisation for the Promotion of vocational Training which is based in Switzerland.

Edward attended Bishop Burton College of Agriculture where he obtained a City & Guilds 394 Agricultural Mechanics certificate. At the same time he gained experience in operating and maintaining a wide range of machinery and equipment on the family farm at Bishop Wilton in the Vale of York.

To enable Edward to represent the United Kingdom in Taiwan he has been seeking £5,000 sponsorship from agricultural engineering and allied industries. The sponsorship is to meet the costs of Edward and the industrial expert and also the air freighting of the special tools and equipment needed for the competition.

The Institution made a contribution to Edward's sponsorship requirement and we are pleased to learn from his recent letter that he now has sufficient funds to make the visit to Taiwan. We wish him every success in the venture.

Maintaining amenity grass safely

Risk assessment has recently (and deservedly) gained a high profile, explains Bob Stock. It is now a legal requirement contained in 'the Management of Health and Safety at Work Regulations' which came into effect on the 1st January 1993.

There is nothing new about risk assessment. It has always been the cornerstone of health and safety management. You cannot after all hope to manage risk unless you fully understand the risks you are trying to control.

Many of you will already have been carrying out risk assessment, either consciously or unconsciously, at your workplace. But beyond that, we are all involved in risk assessment on a day-to-day basis. Anyone who drives a car will have been involved in making important risk assessment decisions when, for instance, deciding whether it is safe to overtake a slow-moving vehicle on a narrow winding road.

Yet despite this familiarity, all too often when it comes to applying risk assessment logically and systematically to a work situation we go completely off the rails. The result is that not only is a satisfactory outcome not achieved, but a great deal of expensive resource is squandered in the process, to no effect.

I suspect that part of the problem may be the terminology used. Assessment is after all a familiar enough word. It means the business of weighing up a situation; of making judgements preparatory to taking action. However, the word 'risk', whilst familiar enough, is used very loosely and this can give rise to confusion. I therefore hope to show the meaning of the word risk when used in this specialist context by means of some illustrations from the world of amenity grass management.

I decided to use examples relating to the interface with the general public, because in many ways this is a unique feature of amenity grass.

R Stock is Inspector of Health and Safety with the National Interest Group for Forestry, Agriculture and Allied Industries, Edinburgh.

Paper presented at the Scottish Branch Conference, Amenity Grassland, Perth, 24 February, 1993.

The hazards

I ask you to imagine the following scene depicting a number of hazardous situations. A small boy on a bicycle is furiously pursuing a gang mower, hell-bent on overtaking it. If he succeeds, or the tractor makes a sudden turn, he may well end up squashed, or minced. Nearby a strimmer operator is working near a hedge behind which is a couple of lovers. At this close range they are in real danger of being struck by a high velocity projectile. On the other hand if their parting present is a used condom, the strimmer operator may well perceive this as posing a hazard to his health. Certainly the present which is being left by a small dog presents a real possibility of a health hazard. The little old lady who owns the dog is probably totally oblivious to the fact that her dog's stools may be infected with Toxocara larvae, however if the dog drops down dead when she gets home, her first suspicion will be that it has consumed some hazardous substance which you have been using for controlling weeds, moles or worms. And finally there is a degenerate looking young man who is about to discard a hypodermic needle, which will clearly be potentially hazardous both to other members of the public and to the amenity grass workforce.

The important thing to realise is that these are all hazardous situations – hazards. A hazard can conveniently be defined as 'a source of possible harm'.

Whilst it is important to identify all the hazards in your amenity grass situation, it is not the hazards that you are legally required to assess. What you are required to assess, and what you want to assess, is 'Risk'.

The risks

A risk can be conveniently defined as 'the likelihood of a hazard actually causing harm'. So having identified your hazard you then have to evaluate two additional factors. Firstly the likelihood of occurrence. This is in turn a function of both the frequency at which the activity is carried out and the number of people who are likely to be exposed to the hazard on each occasion. Secondly you will need to evaluate the degree of harm caused. This we can usefully label as the 'severity'.

In order to illustrate the logical steps which you would take to do this it is instructive to consider the degenerate young man discarding his hypodermic needle. I choose this illustration, not because it is necessarily the one which should give you the most concern (the reverse is probably true) but because it may be something which you haven't given a lot of thought to and which you can therefore consider with an open mind.

The assessment

Let us first consider the hypodermic needle encapsulated in its sealed sterilised pod. We

Fairclough Report

Regional discussion meetings

The recently published Fairclough Report on unification in the engineering profession concerns professional engineers of all disciplines.

A series of regional meetings has been organised for engineers to meet and discuss the report end.

If you have not already made known your views, you may still be in time to attend one of these meetings. Here are details of meetings from end June onwards:–

Although the meetings have been organised by the Institutions of Civil, Chemical, Electrical and Mechanical Engineers they are open to all engineers.

Date	*Location*	*Organiser*
Tuesday, 29 June, 6.30pm	Crabtree Lecture Theatre, Mechanical Engineering Dept, University of **Leeds**	IEE
Wednesday, 30 June, 6.30pm	Room C1.8, Pope Building, University of **Nottingham**	ICE
Thursday, 1 July, 6pm	Strathclyde Council HQ, India Street, **Glasgow**	ICE
Wednesday, 7 July, 5.30pm	Large Lecture Theatre, School of Chemistry, University of **Bristol**	ICE
Wednesday, 7 July, 7pm	Lecture Theatre 6, Babbage Building, Drakes Circus, University of **Plymouth**	IEE
Monday, 12 July, 6.30pm	Boxley House Hotel, Boxley, nr **Maidstone**	ICE
Thursday, 15 July, 6.30pm	Prince Philip Theatre, UWCC, Newport Road, **Cardiff**	IEE

can say with reasonable certainty that in this condition it is harmless (unless perhaps you swallow it or give it to the baby to chew!). Once the needle is unsheathed and removed from its protective covering it then has the potential for making a wound. Suppose it is then used, discarded and re-discovered. At this point your risk assessment would depend upon the location at which it is re-discovered. If it were found in a farm-yard then you could say with reasonable certainty that it had been used for injecting animals and your assessment would be based upon the likely transmission of animal diseases, tetanus and general bacterial infection. If it were found in a hospital then it would be almost certain that it would have been used for injecting a human being and your assessment would take this into account. If on the other hand it was found discarded on amenity grassland one could say it was 99.9% certain that it had been discarded by a drug user. And they, as we know, are a high risk group for various infectious agents such as Hepatitis B and HIV. Suppose then this infected needle has a close encounter with the nylon filament of a strimmer or perhaps the blades of a hover mower so that it is hurled through the air at great speed. Then the possibility arises of it being embedded in the flesh of a member of the public or amenity grassland workforce.

The action

The foregoing steps have allowed us to evaluate the severity of the outcome. What we now need to consider is how likely is it to happen. Well that will depend on the particular situation – whether it is an urban site, a rural site, a golf course or a public park. Drug abuse may only be a theoretical possibility in your situation. On the other hand you may know that in certain parts of your amenity grassland hypodermic needles are to be commonly found. Only you can judge this. And your judgement will determine the resulting action, which may vary from doing nothing, to providing appropriate instructions, to perhaps adopting some method of grass control which doesn't involve use of strimmers, hover mowers, etc.

Other scenarios

It is interesting to contrast that risk assessment with the one that you might carry out for the discarded condom. Potentially here we have the same possible infectious agents. And we have the same piece of machinery ie strimmer. However, because there is no mechanism involved which is likely to cause a wound (and that is the means of infection), then I think it is most likely that your assessment will conclude that the risk is so small that it can be discounted altogether.

In the case of the gang mower it is the interface between the general public and machines which is in question. This I suspect is in an area which most amenity grass managers will have given a lot of thought to already. The assessment is going to vary with the intensity of public use. Where this is very high it may affect your choice of machine. More likely it will affect the time of day and day of week when you choose to do your grass mowing. Instruction and training of operatives is also clearly crucial in this type of situation.

If you are managing amenity grass you will be lucky if you have not had to face up to the problem of dog muck. Apart from being particularly unpleasant stuff there is a possibility that it can contain the larval stage of a worm *(Toxocara canis)* which is capable of producing harmful health effects if transmitted to the human body by the eyes or mouth. Because this is the only mechanism of infection it can normally be satisfactorily combated by basic hygiene measures, and in the case of strimmer operators via the use of the protective face shield which would in any case be being worn for other reasons.

If the little dog has died as a result of consuming hazardous substances used in pest control then it is fairly likely that you will not have met your duties under the Control of Pesticides Regulations and the Control of Substances Hazardous to Health Regulations. However, hopefully, your risk assessment will have dictated that you use products and methods of application which precluded the possibility of such an occurrence. There are a lot of issues to be considered.

First and foremost is the actual product chosen. Where public access is particularly intense and the risk is assessed as being high then there may be a case for sacrificing the effectiveness of the product in order to achieve a really high level of safety.

The form and method of application is also important. Granular formulations generally tend to be the safest, but there might be occasions (for instance a kiddies' playground), where you would have to consider whether the granules might be eaten. Weed wipers, controlled drop applicators, knapsack sprayers and tractor sprayers all probably have a part to play in different situations.

Getting priorities right

Of course there will be many other risks that need to be assessed apart from the ones involving the general public. Nevertheless I hope that this short exercise has proved useful in demonstrating the structured way in which a risk assessment is pieced together. I hope also that one thing has become apparent and that is that carrying out risk assessment allows you to prioritise your resources. Once you have carried out your risk assessment you may identify hazardous situations where the risk is so low that nothing needs to be done, or where routine measures instituted for other reasons adequately control the risk. This will allow you to use your resources to target those remaining situations which have been identified as high risk.

Following his paper, Bob Stock invited questions from the floor:–

Q: **What is the statistical chance** of being hit with a hypodermic needle as compared with being hit by any other sort of projectile?

A: I cannot answer that question because it's too general. One would need to know the exact situation – the degree of public access, the mowing regime, the degree of drug abuse, etc. Generally it is you, the amenity grass manager, who has best access to this kind of information. For that reason you may be the best person to actually carry out the risk assessment. Alternatively if you do choose to use an outside body then it is essential that you make sure that they have quality information on which to base the assessment. It is like computers – you only get out what you put in.

I don't want you to get the hypodermic needle issue out of perspective. Hypodermic needles are an emotive subject, as are pesticides. One of the advantages of doing risk assessment is that you are able to judge the measures which are really appropriate to these issues. You may then for reasons of political expediency go on to employ much more rigorous measures than are really necessary. However, it will then be an informed decision. You will know what extra resource has been used in providing that extra safeguarding and you won't just have been using the blunderbuss approach of directing the same amount of resource at every hazard in sight irrespective of whether there is low or high risk.

Q: **I have picked up a leaflet** on reporting accidents. Could you comment on the problems of reporting accidents to the public on amenity grassland, when it is often difficult even to know that the accidents have occurred?

A: Firstly the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) does allow a defence for responsible persons to prove they were not aware of the event that they were required to report. That doesn't relieve you of the responsibility of setting up procedures to try and make sure that accidents are brought to your attention. However, supposing that you have done that and, for instance, a contractor fails to notify you of an accident, then you could offer that as a defence and it is possible that the contractors could then be held responsible themselves for the failure to report.

RIDDOR is a relevant statutory provision of the Health and Safety at Work Act, and as such only applies to events arising out of, or in connection with, work activities covered by that Act. Therefore for instance if a member of the public fell into a hole which had been dug by a member of the amenity grassland workforce then this would be reportable if an appropriate injury resulted. On the other hand if the person simply fell over and broke their leg then this wouldn't be reportable. Only major specified injuries to members of the public are reportable – whereas lesser accidents to employees (resulting in their absence from work or being unable to do their normal work for more than 3 days) need to be reported.

Health and Safety

The Health and Safety Executive (HSE) has published an information sheet to help employers decide how to maintain portable electrical equipment. It is aimed at helping small businesses who may be unsure about their legal responsibilities. The information sheet discusses effective maintenance and concentrates on the simple checks which employers can take to ensure equipment is safe.

'Maintenance of portable electrical equipment' is free from:– HSE Information Centre, Broad Lane, Sheffield S3 7HQ.

Good training policy and practice

This guide is produced by the UK Agricultural Supply Trade Association (UKASTA) with Employment Department assistance. It is written with the senior manager in mind – not the training professional. It covers topics such as Why train; The benefits of effective training; Training policy; Integrating a training strategy and Planning the training.

From:– UKASTA, 3 Whitehall Court, London SW1A 2EQ. Price: £30 + £3.20 p&p plus VAT (to UKASTA members: £15 + £3.20 p&p plus VAT).

Booknet

This is a special service offered by the British Library. The aim is the re-distribution of books and periodicals. Libraries which have no further use for material send it to Booknet. The material is listed and lists sent regularly to libraries and organisations (not individuals) who are interested in acquiring books and serials for their own collections.

For further information contact the British Library 0937 546066.

Energy Management

This guide written by Professor Pat O'Callaghan covers ways of reducing costs in efficient energy use. The content includes Fundamental Concepts, Instrumentation, Measurement and Control, Economics and Finance, Use of Computational Aids and Energy Management Checklists.

From:– McGraw-Hill Book Co Europe. FREEPOST SL1 351, Maidenhead, Berks SL6 5BR. Price £40 + £2.50 p&p.

Export Control Information Service (ECIS)

Do I need an export licence? How do I get one? What else do I need to know? If you need these questions answered, the ECIS information service can provide the information. Export controls are currently undergoing considerable changes. A new Export of Goods (Control) Order is expected in December which will include a completely revised control list requiring companies to re-classify all their exports.

From: Delton Ltd on behalf of the Dept of Trade and Industry, Amtest House, 75-79 Guildford Street, Chertsey, Surrey KT16 9AS. Annual subscription: £80.

GATT Market Reports for dairy and meat products

'The World Market for Dairy Products 1992' examines major trends in production, consumption and trade of dairy products. The report provides comprehensive analysis per product category and contains detailed statistics and charts.

'The International Markets for Meat 1992/3' provides similar information on bovine meat.

Both reports available from: Microinfo Ltd, PO Box 3, Omega Park, Alton, Hampshire GU34 2PG, Tel 0420 86848; Fax 0420 89889. Price on application.

Farm waste storage: Guidelines for construction (Report 126)

This 250-page publication from the Construction Industry Research and Information Association (CIRIA) brings together comprehensive information on all aspects of construction of silos and farm waste storage – statutory requirements; planning, design and construction; materials; costs; sources of further information.

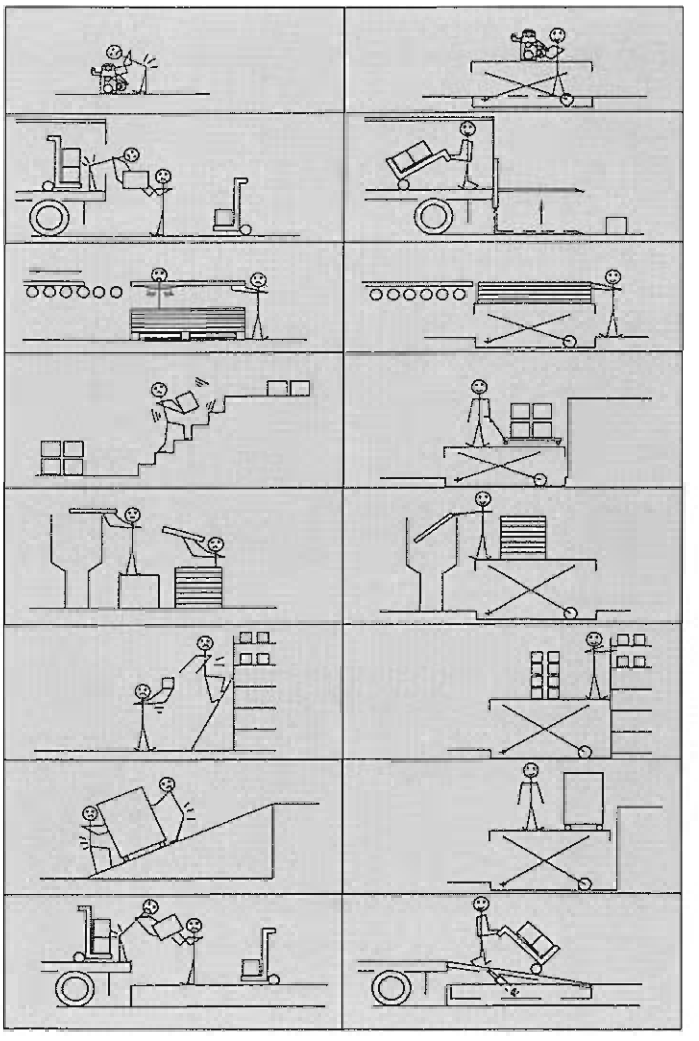
Obtainable from CIRIA, 6 Storey's Gate, Westminster, London SW1P 3AU, price £50 (£25 to CIRIA members).

Manual handling lifting aids

A chart received from ALEM (The Association of Loading and Elevating Equipment Manufacturers) highlights potential hazards in manual handling and lifting and clearly illustrates the many situations where lifting aids can be of benefit: "The time has come," say ALEM, "not only to comply with the new legislation* by avoiding and eliminating the risk of injury to personnel but also to benefit by using lifting aids to increase productivity and cost-effectiveness". The long term benefits can also be costed – reduced employee absence, improved work performance, reduced employee fatigue and the avoidance of possible compensation claims.

ALEM members are ready to offer advice or further information on the applications of lifting and loading equipment in any particular situation. A list of members is available from: The Association of Loading and Elevating Equipment Manufacturers, Carolyn House, 22-26 Dingwall Road, Croydon CR0 9XF (Tel. 081 681 1680).

**The new Health and Safety at Work Regulations implement six European Community directives and the Manual Handling Operations Regulations apply to any manual handling operations which may cause injury at work, including not only the lifting of loads, but also lowering, pushing, pulling, carrying or moving them, whether by hand or bodily force. Employers and employees now have to take three precautions – avoid hazardous manual handling operations where reasonably practicable; assess adequately any hazardous operations that cannot be avoided; reduce the risk of injury as far as reasonably practicable.*



Neighbourhood Engineers

Wiltshire collaboration

Neighbourhood Engineers, the Engineering Council initiative to promote engineering as a career, has been in operation in Wiltshire for some years now, thanks in no small part to **Robert Painting** MIAgrE who has been actively involved from the start. Recently he has been invited to join a similar initiative being set up by the Wiltshire Education, Business Partnership, part of the Wiltshire TEC (Training & Enterprise Council).

The new move is to set up the "Business in the Curriculum" group, the purpose of which is to advise the WEBP on how best to increase understanding between business and education. This venture has a much larger remit than Neighbourhood Engineers covering as it does all industries. Represented on the WEBP are all branches of schools from primary through local colleges to special schools. Likewise, all aspects of industry are included and the Local Authority.

Robert would particularly like to hear from other members who have been involved with such collaborative ventures in other parts of the country. If you have any comments or advice please drop him a line at: 51 Dauntsey, Chippenham, Wiltshire SN15 4HN.

Launched in Northern Ireland

The Engineering Council's Neighbourhood Engineers initiative, now launched in Northern Ireland, will follow similar lines to those in the rest of the country – post-primary schools will receive practical support and advice from local professional engineers and technicians. These engineers will give short presentations to the pupils demonstrating the roles and rewards of working in their own particular field.

Neighbourhood Engineers will be managed in the Province by the industry-education links body, Industry Matters Ltd. The scheme will be part of a wider project supported by the Training & Employment Agency which aims to promote awareness of engineering and career opportunities within the engineering industry.

Northern Ireland has a strong engineering tradition, agricultural engineering in particular has featured prominently in its history. Northern Ireland Branch members are urged to support this initiative in order that that tradition be maintained.

Pulling them in

Branch Recruitment Competition

In the annual **Branch Recruitment Competition** there has been quite a turn-around from previous years. Gone is the domination of the Welsh Branch, they have been relegated to sixth position, even Herts and Essex could only manage ninth. New masters of the recruitment campaign are the members of the **Northern Branch**. They scored a massive 25.67% on the Membership Committee's demon scoring system, the operation of which is known only to that band and is incomprehensible to outsiders but is inscrutably fair and 'above board'. In a lowly but still creditable second place was the Scottish Branch with 8.77%, third with a close 8.63% was the Wrekin gang. Tail-end Charlies for 1992 were the South Western Branch but no doubt they are already planning a block-busting campaign for 1993 to lift their standing!

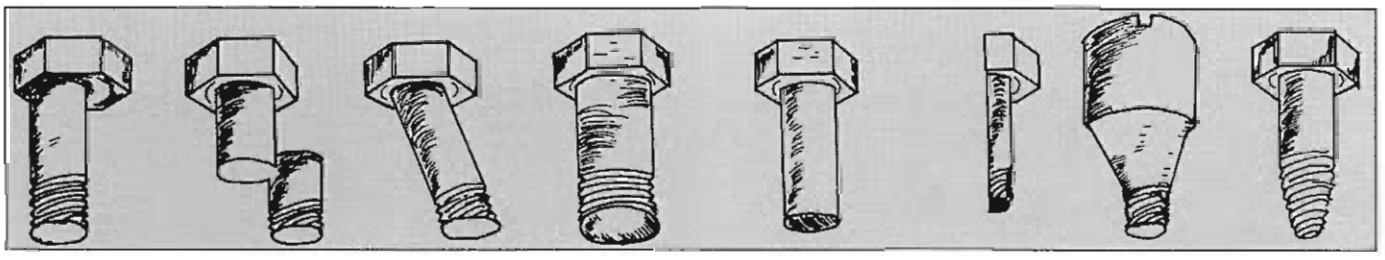
Bolts to save you time – A member's contribution to the drive for efficiency and productivity

Much equipment these days is self-assembly, coming in flat packs. If you think the instructions are difficult wait till you come to the actual assembly. However, don't fret, your problems will be solved by making a selection from our new range of fasteners.

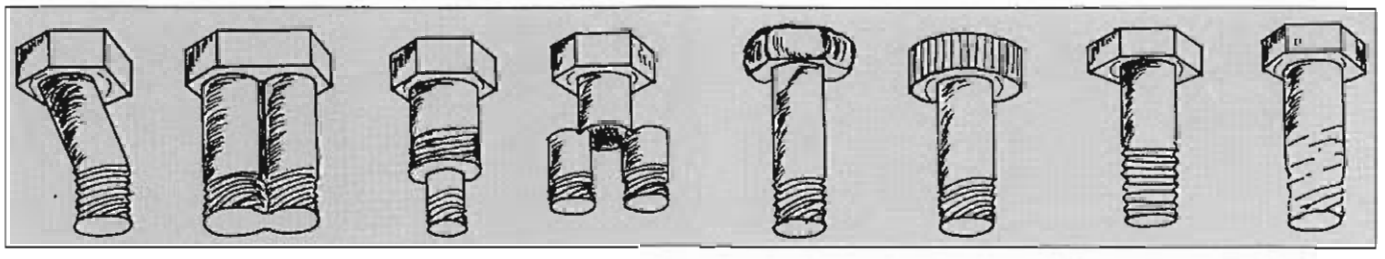
Not only are these fasteners available in A/F and Metric but this year we have introduced Whitworth and Acme thread ranges. If you don't see anything here to suit your needs then please let us know* and we will fabricate to your exact requirements.

**Ideas please to the Hon Editor, The Agricultural Engineer.*

UNIVERSAL BOLT CHART



For holes too near the edge | For mis-matched holes | For holes not drilled straight | Oval bolt for out of round holes | For threadless bolt holes | Half bolt for tight edge work | For holes counter-sunk too deep | For tapered holes



For holes drilled crooked then straight | Binocular bolt for double drilled hole | For holes drilled too small then too big | For redrilled holes that still don't match | Pre-rounded head for worn or over-size spanners | Serrated head for tightening with vice grips | Neutral thread for left or right hand tappings | Pre-stripped for easy over-tightening

Getting a grip on friction control

David James and Bill Lloyd Smith describe the factors affecting the choice of metals and coatings which influence the security of bolts and nuts. Friction control also gives the benefit of predictable flow rates during automatic assembly.

Nuts, washers and bolts come in many and varied shapes, sizes and substrates. Today, most fastenings have a surface coating of some sort. Coatings can improve corrosion resistance, they may improve appearance or they can modify surface properties in some way – as in lubricity. Today all three reasons are common requirements.

A simple and obvious way of reducing friction between two surfaces of a fastening is to apply a blob of grease or a squirt of oil. Certainly the friction plummets but then too low a friction can lead to over-tightening and premature breakdown. The ideal answer is to control the friction.

Threaded fasteners – the principles

Threaded fasteners are the classic components on to which lubricants have the most dramatic effect. However, before discussing typical systems of friction control it is important to understand the workings of an assembled joint.

Assembled joints are subject to strict laws of physics most commonly represented by the stress/strain curve.

All threaded fasteners are assembled and tightened within the elastic deformation range for a given size and strength of bolt; greater clamping forces are obtained by operating in the elastic range. Operating in the plastic deformation range does not contribute anything towards joint security.

Smaller, harder bolts require the same clamping force but higher induced stress than larger, softer bolts. There are obviously significant cost savings in all aspects of assembly productivity in the use of smaller, harder and more highly stressed fasteners. However, as the size and hardness of the components becomes smaller and higher, respectively, this automatically means that the correct tightening characteristics become more and more critical.

Tightening techniques

All threaded fasteners must rely upon the transfer of a turning movement (torque) via the thread form into an axial stress (tension) of the bolt or screw. The elastic component of this bolt tension transfers the tension induced into the bolt or screw into a clamping load between the joint faces. It is the joint faces that carry the load and not the bolt.

It is the controlled improvement of this transfer of a turning movement into a correctly predicted axial tension that is the goal of the fastener applicator. If we have too much transfer we may get bolt fracture or thread stripping. If we have insufficient bolt tension then we get poor clamping, insecure joints and, probably, bolt fatigue failure. Insufficient transfer of turning movements is nearly always due to too high a coefficient of friction on the mating threads. A seized nut, for example, would shear a bolt with very little, if any, induced tension in the bolt.

Conventional tightening techniques for fasteners rely upon measuring a turning force by plotting a Torque Tension graph. One can easily establish the relationship between the force applied, say, with a torque wrench, or with a spanner, and the induced tension in the bolt. This relationship is dependent, however, upon the coefficient of friction between the surfaces in contact and, in the case of a high coefficient of friction – in particular in metals like zinc to zinc – that coefficient of friction can be high. So, bolts with high coefficients of friction that are tightened to the same loads as those with low coefficients of friction will, quite naturally, have much lower values of induced tension.

It is therefore, critical that a predictable surface coefficient of friction can be attained in order to achieve satisfactory tightening characteristics especially in the safety critical applications such as: wheel bolts, seat belt bolts, steering bolts, seat bolts and so on.

Fig 1 illustrates a torque/tension curve and its interpretation.

An acceptable torque/tension curve is generally shallow with a narrow scatter band, whereas an unacceptable torque tension curve is steep with a large scatter.

The application of a lubricant dramatically influences and changes the shapes of the torque tension curves and allows a specific torque tension relationship to be achieved.

It is important to note that the coefficient of friction of a lubricated surface depends more on the lubricant that is applied rather than the nature of the substrate coating.

Friction control

Friction control techniques can be classified into three groups:–

- Untreated metals
- Lubricants applied to a coated surface
- Lubricants integral with a coated surface.

– untreated metals

The most popular metal to metal joint found in the fastening industry today is undoubtedly zinc, but a zinc to zinc joint is notoriously unreliable due to the metal having an adverse coefficient of friction. It is a fact that most like-metal joints are poor. Aluminium and stainless steel are particular examples but zinc, although the most popular coating in terms of corrosion protection and appearance, is quite the worst example of joint security.

Of those metals commonly used in metal finishing only cadmium and chromium possess the ideal properties of low coefficient of friction.

Cadmium is chosen for a combination of its appearance, salt spray resistance, and lubricity. Chromium is normally used for applications calling for, primarily, lubricity,

Table 1. Torque/tension values vs percent lubricant concentration.

Coating	*Lubricant and concentration*	*X*	*R*
Phosphate	Oil ?	5820	430
Mechanical zinc plate	None	1988	450
Mechanical zinc plate + chromate	None	2266	310
Mechanical zinc plate	1% A	4759	1445
	2% A	5090	1000
	5% A	6037	1350
	10.00% A	6120	1025
	20.00% A	6373	1385
	100.00% A	6557	380

Note: 'X' is the average load in lbs. 'R' is the standard deviation
Test specimen = Skidmore – Wilhelm and Beam type torque wrench

D G James is European Marketing Manager for the Industrial Products Division, MacDermid Ltd. W Lloyd Smith runs Key Management Services, Marketing Consultants.

hardness and wear resistance.

– applied lubricants

The second classification group, and by far the most popular, is that group consisting of lubricants applied as a surface coating. It is in this group that both the reduction in the coefficient of friction, as well as the ability to control the level of lubricity, becomes possible. In fact, the control of friction by this technique is one of the best demonstrations of the ability of a metal finishing industry to satisfy the end-user's needs.

Chemical friction control techniques can be applied to coated or uncoated metals and in some cases friction control can be achieved as part of an integrated coating system.

Surface lubricants are the only group of processes that give relatively easy and simple control of the torque/tension relationship. They do so by:–

- flexibility of choice
- the modification of surface properties by the control of the concentration of the lubricant at the surface.

The control of surface properties by varying the concentration of a typical surface lubricant is illustrated in Table 1. The higher the figure in column 'X' the better the transfer of applied torque into induced tension.

Increasing the lubricant concentration beyond the optimum does not give corresponding improvements in the coefficient of friction.

– integral lubricants

The third classification within friction control concerns integral coating lubricants. Coatings containing co-deposited lubricants probably represent the best performance choice for the modern fastener engineer.

With integral lubricity, the performance of the system is maintained throughout the working life of the system. Processes are available which consist entirely of fluorocarbon or, as an alternative, contain fluorocarbon co-deposited in a zinc flake dispersion within electroless nickel, or within mechanically plated zinc.

The obvious benefits of a co-deposited lubricant are the fact that it is permanent, it should not be affected too much by re-use, it cannot be washed off, and it is reasonably inert. The disadvantage, of course, is that special chemistry is needed and, as a consequence, it is probably more expensive to deposit compared to the cost of applying a surface coating lubricant.

Areas of benefit

It is the automative fastener industry which has made the major contribution and benefited the most from improvements in friction control. As the quality standards improve, and end-user demands become more critical, then the more we will experience, as a meta finishing industry, the need to utilise friction control techniques.

In practice, in many environments, the benefits of having the ability to control friction and torque can be clearly demonstrated.

For example, faster component feed rates can be achieved in machinery that has to collect or utilise a single component from a heap of like components without creating a blockage or misalignment – such as: shoe nailing machines, nail collating machines, automatic robot assembly.

The ability to create less friction in components nestling together results in their being able to be packed into a smaller volume. Greater packing density, with savings in packaging, is the most obvious advantage but the added advantage of the ease of packing to either machine or operative should not be underestimated since the end result is far greater production throughput.

Further benefits may be seen in the furniture industry as in the slide characteristics on brass hanger rails in wardrobes or drawer slides, hinges, filing cabinet runners. Also, one can instance the improved drivability of plated nails.

The cost of a correctly applied lubricant is only a tiny portion of the achieved productivity/safety benefit.

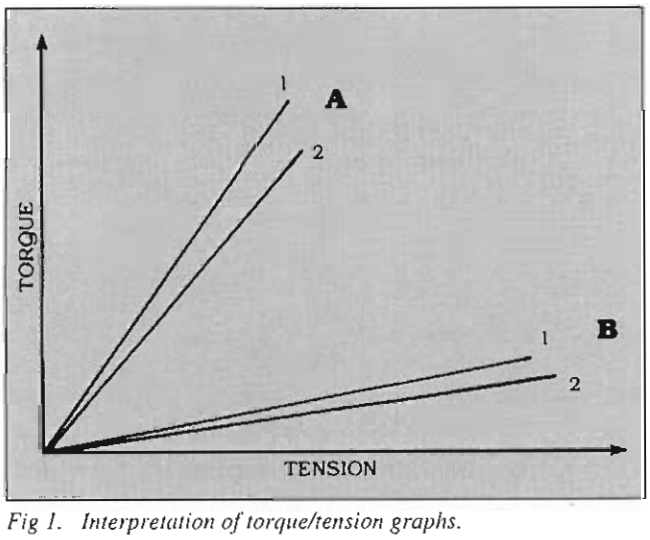


Fig 1. Interpretation of torque/tension graphs.

Each graph is automatically plotted during each test and produces two curves –

Curve A

– Represents the total turning force (torque) required to tension the bolt;

Curve B

– Represents the part of the total torque applied to the threaded portion of the bolt to achieve the same bolt tension;

Curves 1, 2

– Represent the replicate torque-tension tests plotted on the same graph paper.

Notes:

1. Subtracting the thread torque from the total torque values will produce a torque figure representing the bearing face torque, i.e. the 'under-head' torque.
   Although not shown graphically here, the value of the 'under-head' torque can be plotted against bolt tension.
2. Coefficients of friction can be calculated for:

total torque	vs	tension
thread torque	vs	tension
'under-head' torque	vs	tension

3. High coefficients of friction (sticky) are shown by steeply angled curves.
4. Low coefficients of friction (slippery) are shown by shallow angled curves.
5. The closer together the curves are in Group A or Group B then the better is the consistency and predictability of the tightening procedure.
6. Generally speaking, unlubricated surfaces have steeply angled torque-tension curves widely scattered.
7. The difference between the total torque-tension curves and the thread torque-tension curves is a characteristic of the fastener rather than the lubricant.

July

4–6 Symposium — **ISEB 2, International Symposium on Environmental Biotechnology**, Brighton.
IChemE, 165-171 Railway Terrace, Rugby, Warwicks CV21 3HQ (Tel: 0788 578214. Fax: 0788 577182).

5–8 Exhibition — **Royal Show**, National Agricultural Centre, Kenilworth.
Melanie Allen, RASE, National Agricultural Centre, Kenilworth, Warwicks CV8 2LZ (Tel: 0203 696969. Fax: 0203 696969).

6–9 Symposium — **Fourth International Livestock Environment Symposium** – sponsored by ASAE in co-operation with RASE and IAgrE – University of Warwick Conference Park, Coventry.
ASAE Meetings Dept, 2950 Niles Road, St Joseph, Michigan 49085-9659, USA (Tel: 0101 616 429 0300. Fax: 0101 616 429 3852).

19–22 Exhibition — **Royal Welsh Show**, Llanelwedd, Builth Wells, Powys.
Peter D Guthrie, Royal Welsh Agricultural Society, Llanelwedd, Builth Wells, Powys LD2 3SY (Tel: 0982 553683. Fax: 0982 553563).

September

2 Symposium — **Alternatives to shortwood working** – Forestry Engineering Group IAgrE Symposium, Newton Rigg, Cumbria.
Geoff Freedman, Secretary, Forestry Engineering Group, Forest Enterprise, 231 Corstophine Road, Edinburgh EH12 7AT (Tel: 031 334 0303, Ext 2373).

11–12 Demonstration — **West of England 4x4 Festival, Shepton Mallet.**
Derek Jarman, Royal Bath and West of England Society, Shepton Mallet, Somerset BA4 6QN (Tel: 0749 823211. Fax: 0749 823169).

October **3–7** **Saudi Agriculture '93.**

9–10 **British National Ploughing Championships.**

Nov/Dec **28–2** **Royal Smithfield Show.**

December **14–17** **ASAE International Winter Meeting.**

ADVERTISERS INDEX

THE INSTITUTION OF AGRICULTURAL ENGINEERS
FORESTRY ENGINEERING GROUP
1993 SYMPOSIUM

Alternatives to Shortwood

Newton Rigg, Cumbria
Thursday, 2nd September
(9.30 am – 4.30 pm)

FEATURING

Use of Pole Length Timber at the Sawmill	David Balfour
Whole Pole & Forwarder Extraction	Bob McIntosh
Whole Tree & Clambunk Extraction	David Killer

– LUNCH –

Machinery Design	The Machine Shop
Skylining (Whole Trees & Roadside Processing)	Mike Crow
Residual Disposal from Whole Tree Systems	Barrie Hudson

Fees (including lunch)

Members: £40 + VAT
(Block Booking of 3 or more £30 + VAT)

Non-Members: £60 + VAT
(Block Booking of 3 or more £50 + VAT)

Students: £10 + VAT

Further information:

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