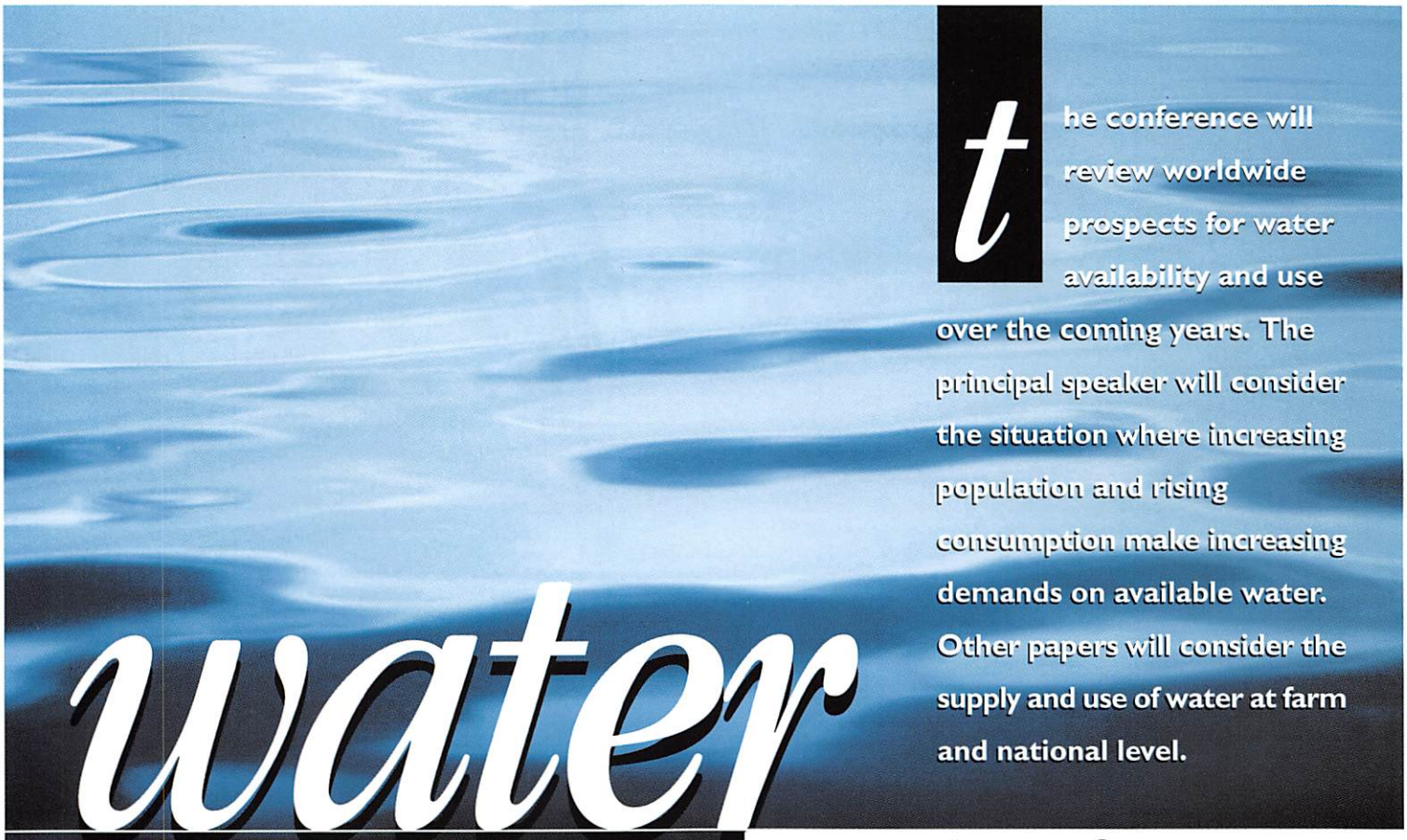
IAgrE Journal

Landwards

Volume 53 No. 4 Winter 1998

Agriculture • Forestry • Environment • Amenity



water

the conference will review worldwide prospects for water availability and use over the coming years. The principal speaker will consider the situation where increasing population and rising consumption make increasing demands on available water. Other papers will consider the supply and use of water at farm and national level.

the key factor

Annual conference

of the Institution of Agricultural Engineers with the Annual General Meeting and Awards Ceremony

Principal speaker
Sir Crispin Tickell GCMG KCVO
"Water in the 21st Century"

Melvyn Kay,
Silsoe College
"Efficient use of irrigation water"

Dr Smail Khennas,
Intermediate Technology Development Group
"Micro hydro-power plant"

Charles Paton,
Lightworks Ltd
"Seawater greenhouse for arid lands"

Martin Lunn,
Essex & Suffolk Water
"Quality water supplies"

Chris Stansfield,
ADAS
"Water storage for irrigation"

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Royal Agricultural College
Cirencester 11 May 1999

Landwards

The Journal for Professional Engineers in Agriculture, Forestry, Environment and Amenity

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17 Market Hill,
Coggeshall, Essex CO6 1TS
Tel: 01376 563811
Fax: 01376 562453

Origination David King
Printing Barr Printers Ltd

Price £12.50 per copy
subscription £47.00 (post free in UK)

Publisher
Landwards is published quarterly by:
Institution of Agricultural Engineers,
West End Road, Silsoe,
Bedford, MK45 4DU
Tel: 01525 861096
Fax: 01525 861660
Email:secretary@iagre.demon.co.uk
Web site at
http: //www.iagre.demon.co.uk

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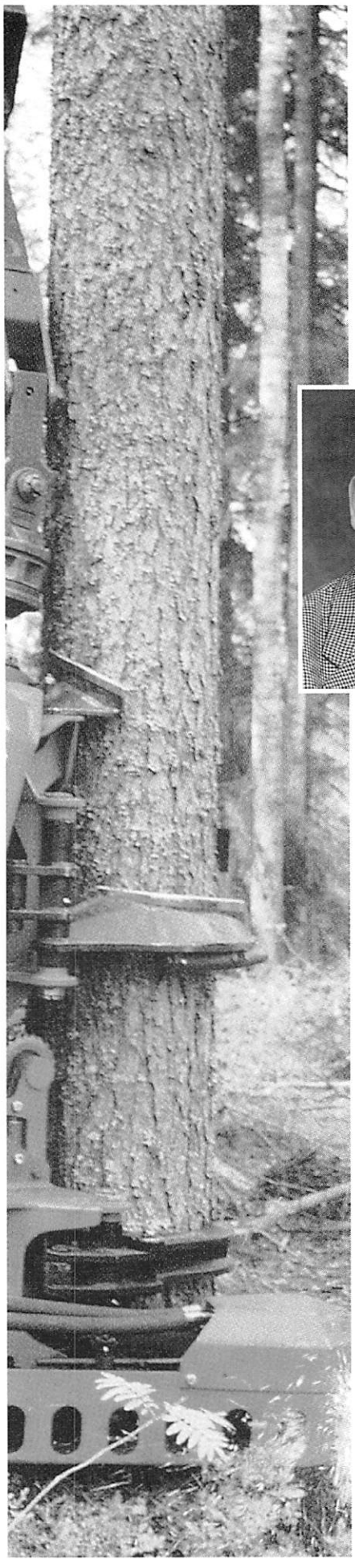
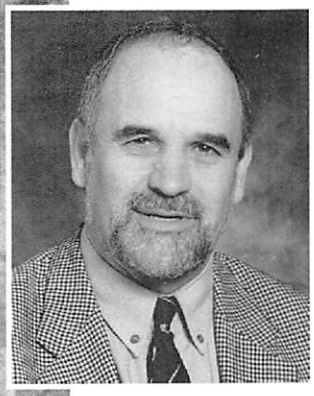
ISSN 1363 8300



Forestry engineering for tomorrow

Geoffrey J H Freedman *Conference Convenor*



The Forestry Engineering Group (FEG) of the Institution of Agricultural Engineers will hold a truly international conference in forestry engineering at the end of June 1999. The idea was spawned during a conference held by the American Society of Agricultural Engineers in Minneapolis in 1997. The forestry engineering groups of these agricultural engineering organisations saw a need to share the work being carried out around the world by many separate small groups. Duplication of research effort is suspected and many well-versed practical engineering techniques in one region are completely unknown in others. Although agriculture is well served by international organisations and conferences, forestry engineering really only has the International Union of Forestry Research Organisations (IUFRO) which specialises in research and is not dedicated to engineering. It is believed that engineering in forestry is the fastest developing of all the engineering sciences and is involved in the majority of the expenditure in forestry.

To risk promoting such a conference was going to take a lot of work, a good deal of risk and total commitment. The idea was first suggested by Prof. Godwin and Prof. Fridley, the 1997 presidents of the agricultural engineering organisations, and the FEG committee gave the response expected of this forward thinking specialist Group in the Institution of Agricultural Engineers. Colin Forsyth, our chairman, gave the go ahead to spend up to £4000 on the call for papers. Colin did so knowing the risk and harmful effects of failure, as well as the commitment, which would be required of him if it went ahead. A sub committee put in many hours at the initial stages and were well rewarded with an impressive response to the call for papers. We have now chosen over 60 of those submitted to be given at the conference.

We were well supported from the beginning when we asked for plenary and keynote speakers. Before we had even sent out the call for papers, the Minister for Agriculture, David Bills (Director General of the Forestry Commission), Rudi Heinrich of the UN, Bryce Stokes of USDA, and Roger Hay had all come on board.

The financial burden was realised when plans began in earnest to organise and underwrite a three day conference for 400 delegates. We have been overwhelmed, however, by the response from industry when we asked for support. The Royal Bank of Scotland and Valmet have given immediate help with the printers' bills for the 'call for delegates' mail drop. UPM Kymmene have sponsored the banquet for the same sum. Forest Enterprise is sponsoring the final day to the field. We have eight professional organisations endorsing the conference and helping with promotion/distribution; and the Institution of Agricultural Engineers have taken on the financial underwriting. We are delighted to report that everyone we have approached within the industry have been enthusiastic in their support which gives us a great deal of confidence that the conference will be a major success. There will be every opportunity for any organisation in the industry to come forward and use the event as a networking situation. This is not a Commercial event - it is a professional meeting run by a charity for the benefit of those working in forestry. Discrete sponsorship of any kind will be welcomed by the committee.

As we are expecting a large number of foreign delegates, we have arranged a full social programme for partners during the

day and everyone in the evenings. The flavour will be distinctly Scottish. The Edinburgh Convention Centre has given us a great deal of help and assured us that people like to visit places of interest when attending a conference. We are taking everyone, in as many buses as it takes, to the Scottish Borders for the third day for a mixture of forestry demonstrations and sightseeing. On the first evening, we will host a formal Scottish banquet in the impressive Signet Library in the Royal Mile, an event for which the delegates will only be asked to pay a fraction of the real cost. Evening two will see everyone dancing at a traditional Scottish Ceilidh in the famous Edinburgh University Union. There will be whisky tasting and a heritage trail on night 3.

The conference will be opened by our chairman, Colin Forsyth, in the Playfair Library at the Old College, followed by a morning of welcome, keynote and plenary speakers. In the afternoon, 23 papers will be presented in 3 parallel sessions. The next day will also have 3 parallel sessions and a further 40 papers. Lunch each day is inclusive and a poster session will be ongoing in the vicinity of the lectures. Accommodation has been pre-booked for 400 delegates and more can be arranged if demand necessitates.

We look forward to your attendance and remember this is not a Commercial venture. It will be a major event in the professional forestry world and it has been put together by volunteers, with professional help, for the benefit of their fellow professionals. Indications are that interest is intense, so please book early and receive the discount.

BOOK NOW: ***see back cover***

Key features

Forestry Engineering for Tomorrow

- International Forestry Engineering Conference by the Forestry Engineering Group (FEG).
- Venue - Edinburgh University from 28th to 30th June 1999.
- Two days of speakers and a final day on site in the Scottish Borders.
- 7 Keynote/Plenary speakers and 64 technical papers (25 from UK, 49 from overseas).

Minister for Agriculture Scotland: *Forestry policy in the UK and its place in International forestry.*

The Lord Provost of Edinburgh: *Welcome to the new top 10 conference city.*

David Bills (Director General of The Forestry Comrnission): *Multipurpose forestry, the Commission's policy and the way ahead for commercial forestry.*

Roger Hay CBE: *Official opening and a background to the conference.*

Bryce Stokes USDA: *Keynote on Roads.*

Rudi Heinrich UN: *Keynote on Harvesting.*

Brian Legg IAgrE: *Keynote on Machinery.*

- Session titles: GIS - Forestry Engineering – Timber – Roads - Machinery - Harvesting.
- Number of conference places – 400.
- Full social programme for partners. Families and partners encouraged.
- Evening events: Scottish Banquet - Ceilidh - Whisky tasting.
- Organisers, promoters and financiers: FEG of the Institution of Agricultural Engineers.
- Chairman of FEG, Colin Forsyth. Conference convenor, Geoff Freedman.
- US partners: American Society of Agricultural Engineers (ASAE).
- Main sponsors: The Royal Bank of Scotland; Valmet.
- Banquet by UPM Kymmene.
- Promoting professional groups:

The Institution of Chartered Foresters
The Institution of Civil Engineers
International Union of Forestry Research Organisations
CIGR
European Society of Agricultural Engineers
Council of Forest Engineering
Southern Forest Engineering Centre

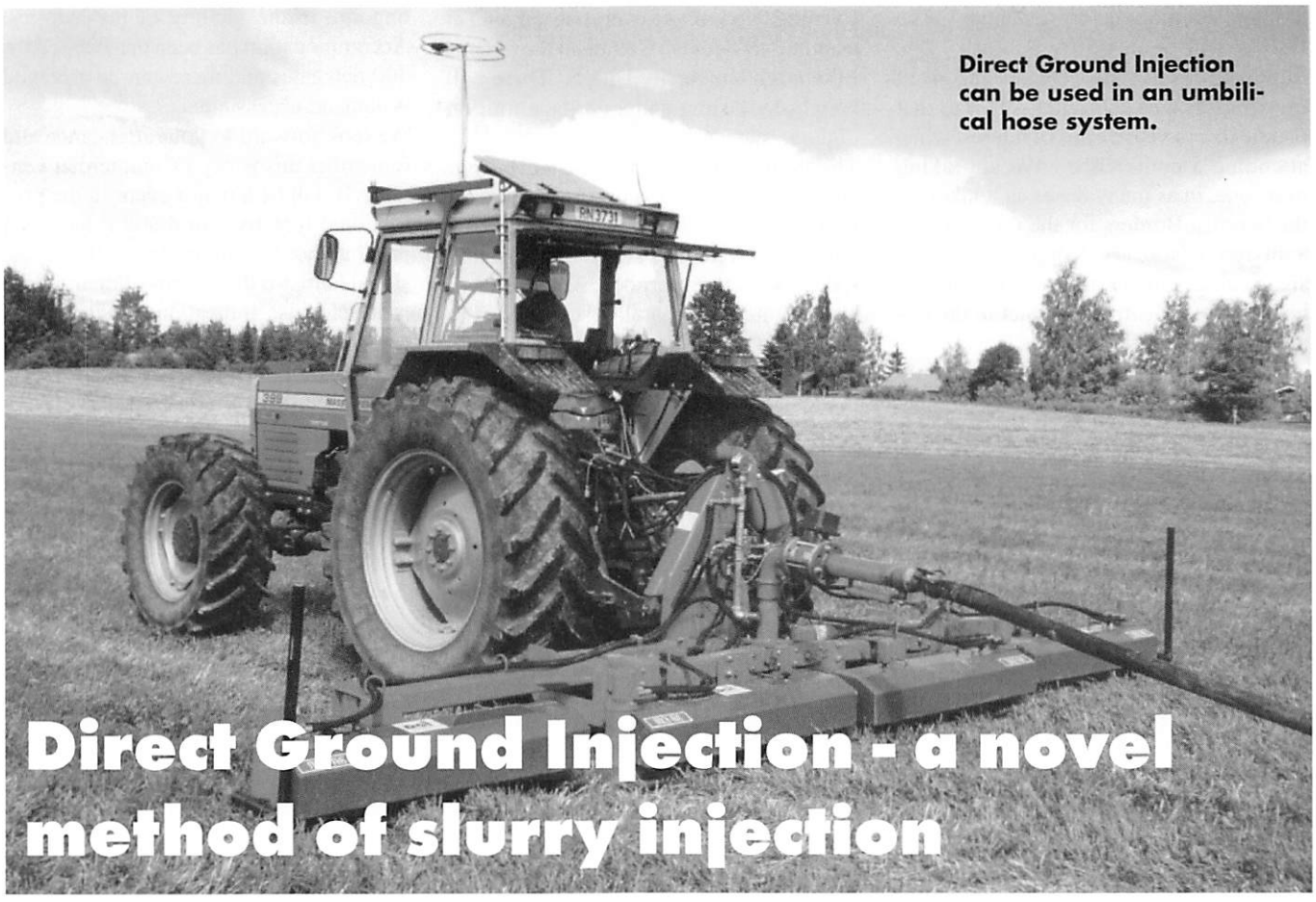
- Costs - £235 for members and speakers or others before the end of January. £290 registering after 31st Jan 1999.

Front Cover Photo. Hagbury Pot Footbridge is a lightweight type of 'Ranger Bridge' so-called because the design loading of 4 kN/m^2 represents a line of hefty Rangers standing shoulder to shoulder all the way across the bridge. For the main beams, the standard Ranger Bridge uses two aerial mast sections sitting side by side, two tubes down and one tube up. This is not the most structurally efficient orientation but it is stable. This is of vital importance because it permits the abutments to be simplified and save construction cost. Two mast sections side by side give a 700 mm wide deck for a 12 m span, whereas three will provide a width of 1050 mm to accommodate quad bikes on a 9m span. The standard mast section means that the longer the span, the smaller is the loading.

All components can be carried across country to inaccessible sites. The 3 m mast sections weigh 50 kg but are easily handled. The end plates are a bit awkward but necessary as end stops for backfill as well as end shear plates. A standard bridge should take about 2 skilled man weeks to construct, a little longer with unskilled volunteers under supervision. The importance of this design is: 'Flexibility; Portability; Buildability.'

The design is protected by British patent No 2 285 078B held by William Haley of Francis and Lewis and Geoffrey Freedman of the Forestry Commission.

The Hagbury Pot Footbridge, near Inverurie, Grampian, was provided by Scottish Natural Heritage, Banff and Buchan District Council and Gordon District Council; and constructed in March 1996 by volunteers from BP's Clair Development Team with the assistance of Bond Helicopters Ltd.



Direct Ground Injection can be used in an umbilical hose system.

Direct Ground Injection - a novel method of slurry injection

John Morken

Introduction

Ammonia emission in Western Europe was calculated to be 8.4 Mt in 1994 (ECETOC). Agricultural activities contribute to more than 90% of these losses. The main source of the losses is livestock production. One other source is the use of fertilizers, which contributes less than 5%, but by far the greatest ammonia losses are from waste, hence the losses from houses, stores, grazing areas, and spreading areas. More than 50% of the losses arise from the spreading of manure or slurry.

Ammonia emission will probably be included in the NO_x-protocols, which means that many countries in Europe will agree on reducing the loss rates in the future. Ammonia emissions lead to acidification of soils, changes in natural flora, and increased damages to buildings of stone or concrete.

Since the spreading of wastes is a main source of emission, an important area for the reduction of emission is in the improvement of slurry spreading technology. Furthermore, a consequence of the way in which modern agriculture has developed is that more and more livestock wastes are applied to grassland or to land that will not be ploughed and without incorporation. Incorporation or injection can reduce or eliminate ammonia emission.

However, many farmers have unsatisfactory experience with the use of injectors. The disadvantages of mechanical slurry injection have until now made this technique unpopular, and these shortcomings can be summarized as high power requirement, low capacity, and damage to the sward, that often has a negative effect on the herbage yield (Morken, 1991). Because of the wide tine spacings necessary to avoid excessively high draught forces, plant growth can vary considerably, depending on the distance between the roots and the slurry deposit.

This paper presents a new technique of introducing slurry to soils (a Direct Ground Injection (DGI®) technique). The results show a reduction of ammonia emissions of more than 70% (Hol and Huijsmans, 1998) as compared with the loss rates from broadcast spreading with splash-plates. The disadvantages associated with mechanical injectors are eliminated. Power requirements are reduced by approximately 50% as compared with mechanical injectors, and no damage to the sward has been reported.

Direct Ground Injection is a patented system for injecting slurry into the soil, and 'DGI®' is a registered trademark from the manufacturers, Moi A/S. The system has been developed in a joint project between Moi A/S and the Agricultural Uni-

John Morken, Doctor Scientiarum (PhD), is a research scientist in Agricultural Engineering, Department of Agricultural Engineering, Agricultural University of Norway, P.O. Box 5065, N-1432 Aas, Norway. He has been project leader in a R&D project that has resulted in the commercial slurry injector DGI® and he summarizes the results of the project in this article

versity of Norway. The system embodies a new design concept that gives a good emission control. DGI® will be launched on the market by the company, ReBio A/S. More information on DGI® will be found at the internet address **www.rebio.com**. The equipment was introduced on the Norwegian market in 1997, and so far 40-50 mqachines are in operation, mostly in Norway, but there are some also in Sweden, Denmark, Iceland, and the Netherlands.

The new DGI® concept

Figure 1 shows a drawing delineating the general principle of the system. The DGI® concept involves a pump to pressurize the slurry (5-10 bars), which is then distributed to nozzles along a boom. There is no device that enters into the soil because the slurry itself is doing the job of injection. The nozzles are located in skis or shoes that slide on top of the soil.

The nozzles can have diameters of 10 to 15 mm, depending on application rates, and the centre to centre distance is 0.3 m *(Figure 2)*. The nozzles jet out the slurry in pulses. Rotating knives ensure that nozzles are not blocked, and these knives also cause the slurry to jet out from the nozzles in pulses *(Figure 3)*. The slurry leaves the DGI® nozzles at a speed of 20-30 ms^{-1}. The pulses are powerful enough to inject the slurry into the ground in elongated, discontinuous cavities. It is obvious that the strength of the pulses from the nozzles determines the depth of injection. The depth to which slurry is injected can be manipulated by altering the working pressure of the DGI®.

The reduction of the velocity of the slurry when it enters the soil is so rapid that the change of momentum of the fluid gives rise to the considerable force that impels the slurry into the ground (and not as head loss). The injected quantity of slurry results in an upward force on the top layer, and this more or less produces horizontal cavities at a depth of 5 – 10 cm, depending on the soil type.

Five nozzles are located on each boom. There may be 2 or 4 booms on a

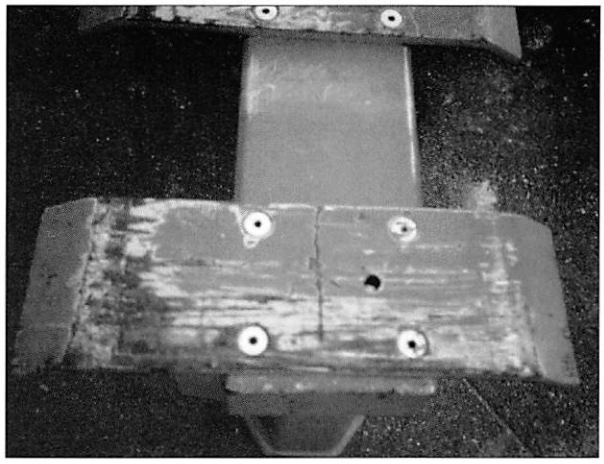


Fig. 2 A section with the skis or shoes. One can see the nozzle openings.

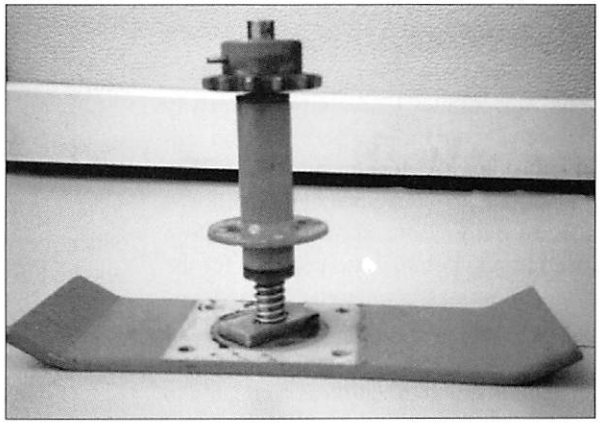


Fig. 3 The rotating knife.

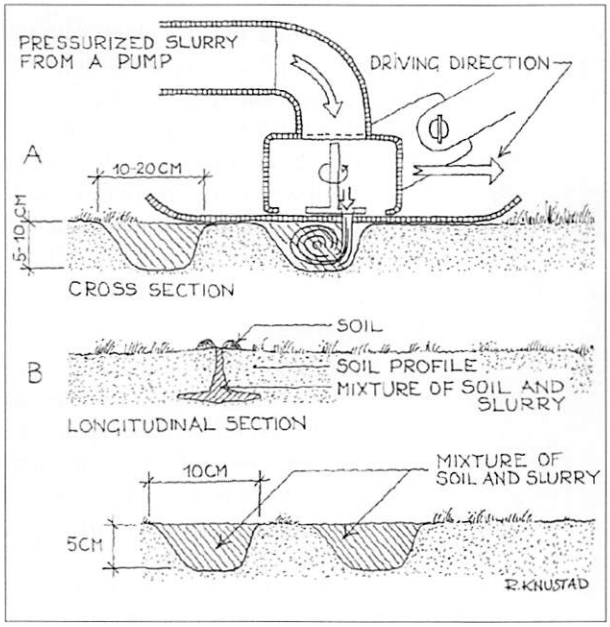


Fig. 1 The principle of the direct ground injection method. (A) Slurry is pressurized by a pump. The slurry then jets out under a ski and into the ground. (B) As the jet penetrates the soil, the manure flow slows down, and a build-up of pressure takes place. This results in an upward force on the top layer, and this in turn produces horizontal cavities at a depth of 5-10 cm, depending on the soil type

Fig. 4 DGI® mounted on a tanker. Working width is 6 m. The machine: (a) when running in the field; and (b) when it is folded for transport.

Table 1. Application technique, slurry type, average nitrogen application rate, and dry matter yield from two cuts located at Aas, Horten and Jaeren, 1997.

Application technique	*Slurry type*	*Mineral nitrogen application rate, kg N/ha*	*Average dry matter yield, sum of two cuts, kg/ha*
No fertilizer		0	3368
Broadcast spreading	Undiluted	116	6000
Broadcast spreading	Water diluted	113	6082
Direct Ground Injection	Undiluted	128	6474
Band spreading	Water diluted	125	6568
Artificial fertilizer		149	7428

spreader, and the working widths will then be 3 or 6 m (10 or 20 nozzles) *(Figure 4)*.

Experiences

Ammonia losses

The Agricultural University of Norway has carried out three experiments on ammonia losses (Morken and Sakshaug, 1997). The first experiment, which was carried out in 1994, showed a reduction in ammonia volatilization of 62% for the first 5 hours as compared to broadcasting of separated slurry. Since the use of separated slurry gives a reduction of 70% in ammonia volatilization as compared to the use of unseparated slurry, we deduced that the DGI® technique had considerable potential as a low emission technique.

In the second experiment (1995), DGI® also gave the lowest emission in comparison to the application techniques of splash-plate spreading and band spreading which were also used. We observed a strong reduction of malodour after the spreading of slurry with DGI®.

In the third experiment (1995), we found no significant reduction of ammonia emission after the addition of water. Therefore, we concluded that this technique is not affected by type of slurry, and that the technique is probably very little affected by weather conditions.

Experiments have also been carried out in the Netherlands (Hol and Huijsmans, 1998). Average ammonia loss in 8 experiments was 23% (application rate 25 m^3/ha). Splash plates (application rates of 14 and 20 m^3/ha) resulted in losses of 81% and 88% respectively. Slit injector (application rate 24 m^3/ha) resulted in losses of 24%.

Dry matter yields

Dry matter yields (grassland) have also been evaluated (Morken and Sakshaug, 1998) (see Table 1). The results indicate that dry matter yield increases when the dry matter content of slurry decreases. If we compare the dry matter yields with band spreading of diluted slurry with direct ground injection of undiluted slurry, the experiments showed that there were only small differences between them. The experiments indicated that the injection technique of Direct Ground Injection gave high dry matter yields in spite of the high dry matter content of the slurry used.

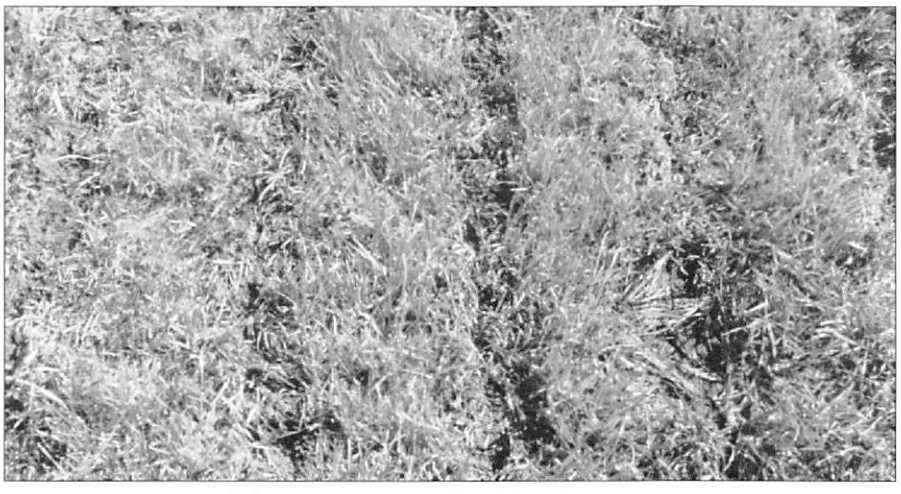


Fig. 5 Injection of slurry into grassland.

Other advantages

Since the slurry jets from the nozzles in pulses, the injected slurry does not form a continuous cavity, and DGI® can therefore be used in hilly terrain without the problem of slurry flowing to the bottom of the hill, a difficulty encountered with ordinary mechanical injectors *(Figure 5)*.

Stones in the soil do not especially influence the performance of the machine, since there is no mechanical device that enters the ground. Machine wear is not influenced by the stone content of the soil, and no buried stones are brought to the surface, thus avoiding potential danger to harvesters and crop processing machinery. There is no specific limit to the application rate but, with current commercial application equipment, it should be below 80 m^3ha^{-1} to avoid slurry appearing on the top of the soil. The system works best when the application rate is below 45 $m^3 ha^{-1}$.

Only a few problems have occurred with blockages of the nozzles. Our experiences also indicate that it can work with slurries with dry matter contents of up to 12-13%. The capacity of a DGI® machine with a 6 m working width is approximately 2 $m^3 min^{-1}$.

However, the use of DGI® on extremely cohesive clay soils can be problematic because of difficulties with the penetration of the slurry in the soil. Although such conditions do not make it impossible to use the equipment, one cannot expect the ammonia reductions to be as high as it would be in more favourable conditions. On loam soils there can be a risk of 'blow-outs' instead of injection.

The future

The technology seems promising. The advantages are that one can use the machine in hilly terrain, and on a great variety of soil types and soil conditions. Furthermore, reductions in ammonia losses and in malodours are advantageous. Since no device enters the soil, maintenance costs are low. Compared with other injection techniques, high capacity, small draught requirement, and low energy consumption are also advantages.

During the last two years, we have mixed seed with the slurry in the tanker, and used DGI® as a direct drill. Thus, seeds have been placed in the soil together with manure. These trials have been very successful. We have used it for grain (absolute 0-till), and for grass seeds, the lat-

ter method being used for sowing seeds in an existing meadow or ley.

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Fruity Britons opt for healthier lifestyle

The 1997 National Food Survey shows Britons eating more fresh fruit than ever before.

Household consumption of fresh fruit continued its long-term upward trend in 1997, rising by 4% over 1996 and being nearly a quarter higher than ten years ago. Consumption of fresh vegetables also rose by 4% (for the second year running) but it was still slightly lower than a decade ago. Per capita consumption of fresh fruit and fresh vegetables by the lowest (decile) income group was 47% and 40%, respectively, below the average over all households in the period 1995-97.

Household consumption of skimmed milk, low calorie soft drinks, mineral water and alcoholic drinks are also on long-term upward trends for the population taken as a whole.

The percentage of food energy derived from fat again fell slightly (to 39.1%, from 39.7% in 1996 and 41.7% in 1992). Percentage of food energy from saturated fatty acids has fallen to 15.3% from 16.3% in 1992.

The percentages of food energy obtained from total fat and from saturated fatty acids in the period 1995-97 were both lower in the lowest (decile) income group than in the population as a whole.

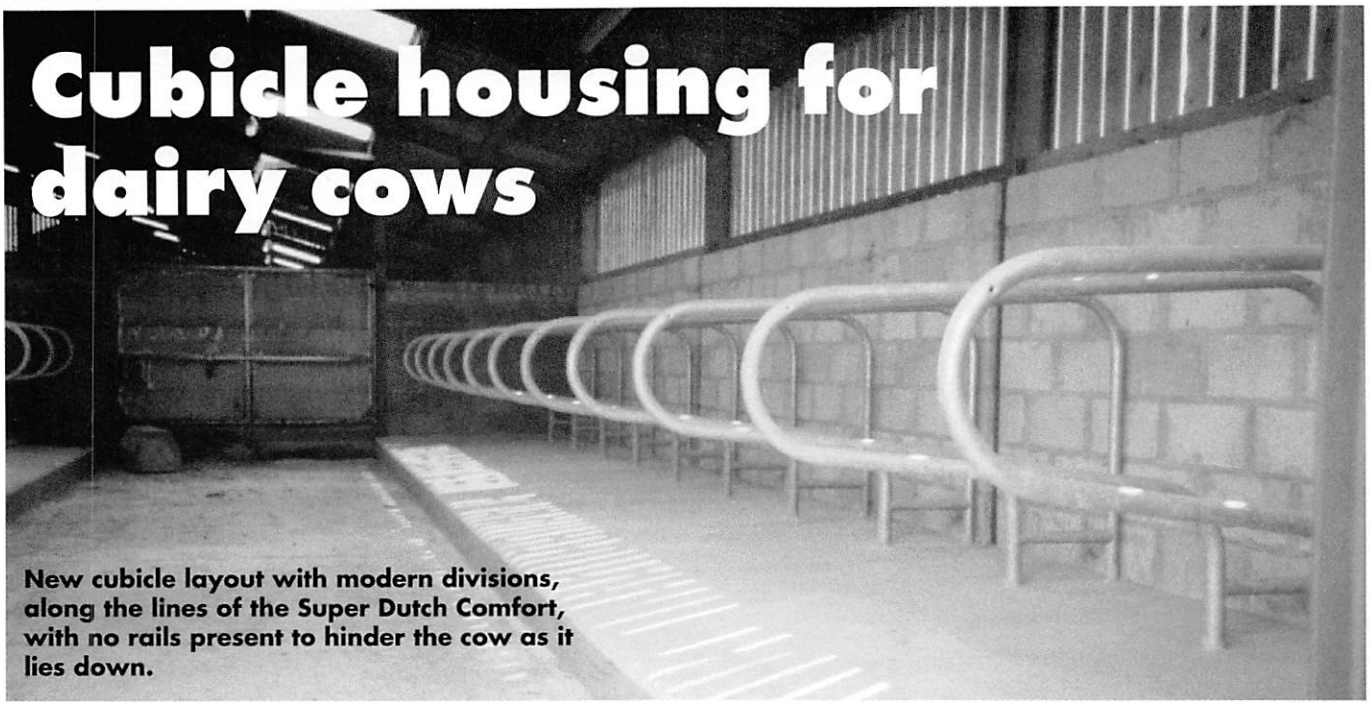
Record trade surplus

Exports: A.E.A. members' exports for the period January 1st to June 30th 1998 declined 2.8% to £834 million against the same period in 1997. Exports remained high despite the high value of the pound against European currencies and the problems in some regions of the world. In order to maintain market access, companies have had to trade on very low margins and British owned manufacturers have suffered severely.

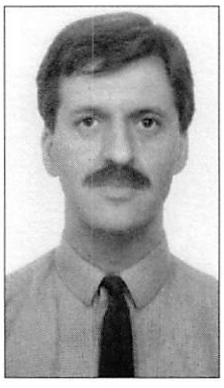
Imports: The severe problems of agriculture have resulted in a 30.7% reduction in imports over the same period, although imports of turf and lawn equipment have increased within that total.

Balance of Trade: The greatly reduced level of imports has resulted in another record trade surplus - up 38.2% to £480 million for the first six months of 1998 following the record surplus of £796 million for the full year 1997. It is doubtful that this can be sustained in the current economic climate and British manufacturers will be seeking to source more components and sub-assemblies overseas to help reduce their costs.

Cubicle housing for dairy cows



New cubicle layout with modern divisions, along the lines of the Super Dutch Comfort, with no rails present to hinder the cow as it lies down.



Richard W Langley

Introduction

Over recent years, average herd sizes in the UK have been increasing (from a 30 cow herd in 1970, to 71 in 1995 (FAWC, 1997), with more concrete and less pasture, and a trend towards cubicles instead of straw yards or tie stalls. Management is much more intensive, with cows typically housed for seven months of the year on many farms. Stresses are being put on the cows, since a conflict now exists between their normal behaviour and the environment into which man puts them.

It has been said that many welfare problems associated with intensively housed animals can be blamed on boredom, *i.e.* they have too little to do. On the other hand, with dairy cows, the main welfare problem is because they have too much to do. The energy demands are greater for a lactating cow than any other form of animal production, or even hard labour in man (Phillips, 1996; Webster, 1993).

The other important issue to consider is quality. According to the Milk Marque (1996), quality begins with the facilities for producing and storing milk on-farm and the provision of good welfare conditions for cows. Clearly then, housing can be considered a crucial piece in the jigsaw.

Cow accommodation requirements

According to Webster (1993), livestock housing should provide the following:

- a clean, dry comfortable bed (to avoid udder contamination and environmental mastitis)
- reasonable shelter from the worst of the weather
- access to clean, wholesome food and water
- sufficient space to move around without difficulty or interference from other cows
- sufficient space and opportunity to express normal patterns of behaviour.

The herdsperson must also be able to direct cows without difficulty to other related areas, *e.g.* parlour, *etc.* In short, the housing should be designed for cow comfort, not for man's convenience.

Cow lameness

Lameness is the result of an adverse reaction between the cow and its enviromnent (FAWC, 1997). Links are now being made between dairy cow housing/behaviour and lameness. The major factors of concern appear to be:

- inappropriate housing, especially poor cubicle design and size;
- long standing times (particularly on rough surfaces), leading to increased, lameness;
- standing in slurry for long periods, with the greater volume of water in the faeces and urine from a silage diet exacerbating the problem;
- slipping on smooth concrete.

It has been estimated that there may be 100 per cent lameness occurring in dairy cows (at some time throughout their lives), by the time they get to slaughter. Interestingly, Hughes (1995) has also reported that a cow's foot is one third heavier in spring compared with what it was at the start of housing.

Lying times

One primary objective, therefore, must be to get the cow to lie down as much as possible once it has been housed. The type of base and bedding affects the lying time of the cow; the more resilient and softer the surface, the longer the cow rests. The cow lies for 12 - 18 hours at

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Table 1 - Dimensions of cow cubicles (BS 5502, Part 40)

Mass of cow, kg	*Dimensions of cow cubicle*	
	Length inc. kerb, m	*Width between partitions, m*
350 – 550	2	1.00 – 1.10
500 – 600	2.15	1.10 – 1.15
600 – 700	2.3	1.15 – 1.20
700 – 800	2.5	1.20 – 1.30

pasture and 14 hours in comfortable cubicles, whereas the time may only be 6 - 7 hours in poorly designed cubicles. The average time to aim for is 8 - 10 hours per day in cubicles (Phillips, 1996).

General aspects of cubicle design

The majority of UK herds are now using cubicles. This form of housing became popular for cows in the late 1950s/early 1960s, mainly due to the large savings in labour and the amount of bedding material required. The popular space-saving argument may not be applicable; the ideal space required for a 600 kg Friesian cow is about 5 square metres in a straw yard, but only 2.6 square metres in a single cubicle. However, the actual *total covered space is* roughly the same for both systems, at 8 square metres per cow. Welfare codes also state that *all* cows should be able to lie down at the same time. (Some in fact go further, stating that there should be 5% more cubicles than cows). When the cow rises from the floor, it lunges forward by a considerable distance, *e.g.* 0.7 - 1.1 m for a 600 kg Friesian. In fact, the cow goes through 30 different movements as it gets up. The main requirements are that the animal must be able to:

- move from a lying to standing position without difficulty;
- lie in a normal position without a risk of being trodden on or kicked by other cows;
- stand all 4 feet in the cubicle, but must urinate and defecate in the passageway;
- lie with its whole body on the cubicle bed.

Poorly designed, tight cubicles might lead to inefficient digestion as the cow lies badly. If the cubicles are too short, this may result in mastitis, teat injuries and general lameness; cubicles that are too long or too wide can also lead to problems.

Cubicle dimensions

The cubicle length is considered to be the most important dimension; the width, to some extent, can be shared with the adjacent stall. According to Phillips (1996), the width should be in the range 1150 – 1220 mm; other experts put the ideal dimensions to be 2.4 m long by 1.2 m wide. It is probably better to base the cubicle size on the weight of cow, and this is what BS 5502 Part 40, 1990 (Table 1) specifies.

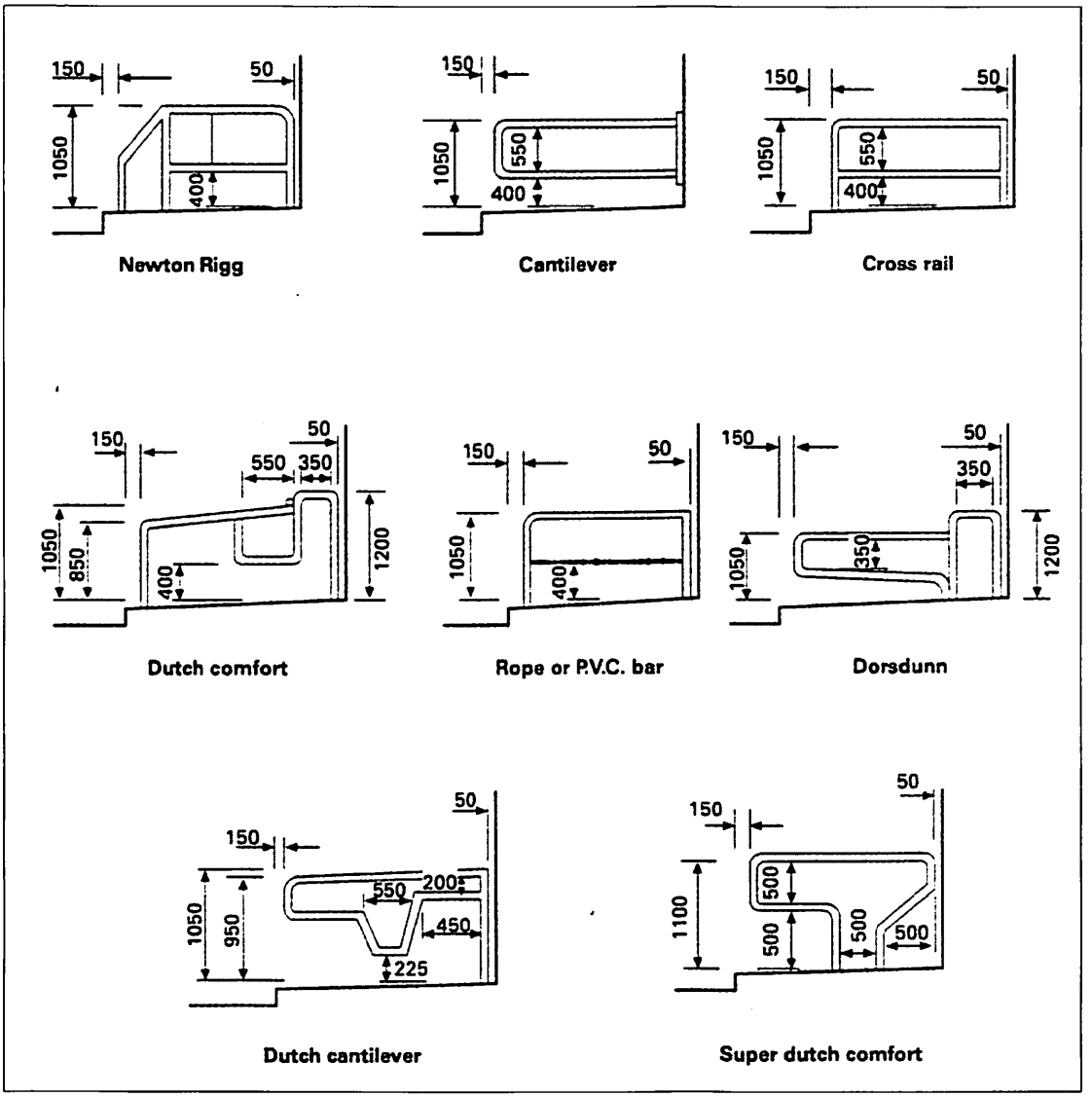


Fig. 1 Cubicle divisions (CEM, 1994). Notes: (1) all bases assumed to fall 75 to 100 mm; (2) cubicle base length and hence division length should be sized using BS 5502, Part 40; (3) all dimensions in mm; (4) all steel tube assumed to be 50 mm O.D.

Cubicle partition/ division design

The requirements of the division are that it must:

- align the cow properly in its own cubicle;
- prevent its feet interfering with or injuring its neighbour's;
- minimise the risk of injury to limbs or teats as the cow changes position;
- be a space-sharing design, and provide three zones of free

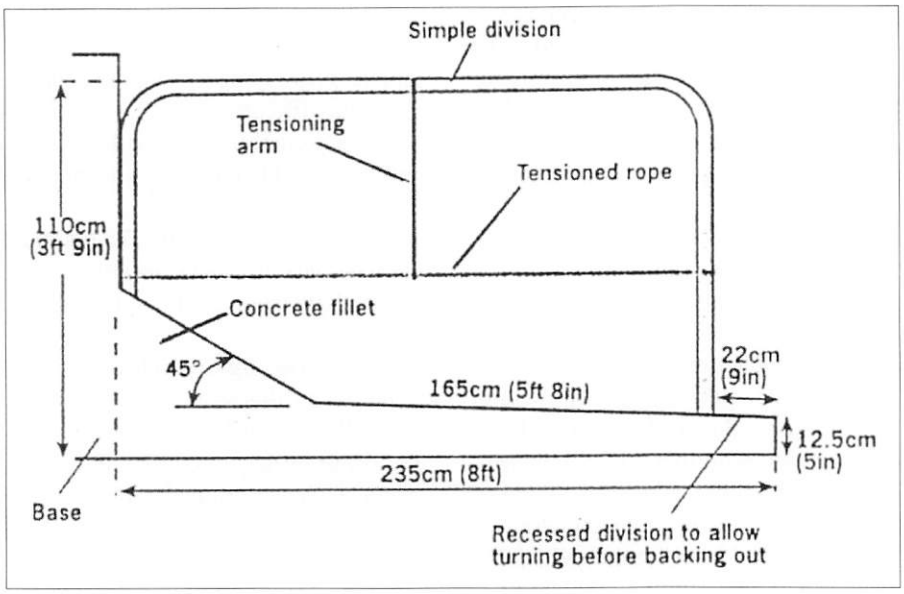
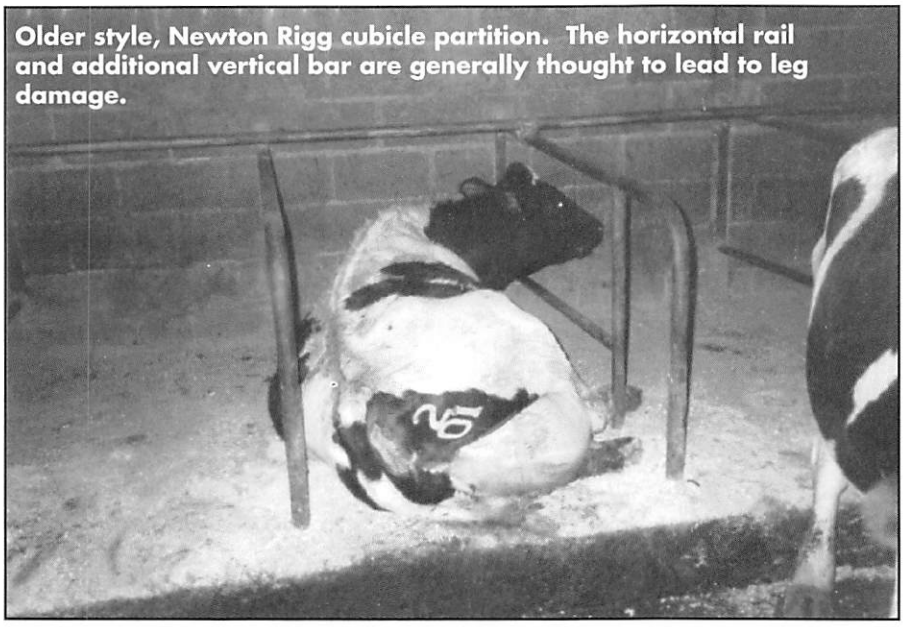


Fig. 2 Cow comfort cubicle design (Hughes, 1995).



Older style, Newton Rigg cubicle partition. The horizontal rail and additional vertical bar are generally thought to lead to leg damage.

space for the head, ribcage and pelvic area.

In many traditional designs, there is a solid horizontal rail at 300 mm from the base. This is now generally frowned upon since the cow's legs can easily become trapped or even broken in this layout. The current trend is to minimise the amount of pipework or other rigid material that can trap legs. For example, the solid horizontal bar is often replaced with polypropylene rope which 'gives' and can easily be cut in an emergency. The bottom rail (where present) should be 350 450 mm from the base; too high and the cow can become wedged under it, and too low causes bruising to the rib cage. The top rail should be 1110 – 1170 mm up from the base. The division needs to be 150 mm *maximum* from the heelstop, in order to prevent the cow trying to walk along the edge of the base.

Most of the current cubicle divisions are shown in *Figure 1*, but it must be said that the Super Dutch Comfort (or 'mushroom' type), the Dutch Cantilever and the Dutch Comfort are by far the most popular; because they go a long way towards meeting the requirements set out above. The cantilever types are advantageous if fitting cubicle mats, since they make the job much easier. The once favoured Newton Rigg is now some 20 years old, and has become obsolete.

It is important that the headrail, which prevents the cow standing too far forward and defecating/urinating on the bed, is positioned correctly. In many cases, this headrail can be adjusted to suit the size of cow; the rail should be 150 – 250 mm *below* the height of the withers. A brisket board (100 mm high) is sometimes used for the same purpose. Hughes (1995) has designed a cubicle base incorporating a fillet of concrete at the front; this has the same desired effect, and there is no need for a headrail (see *Figure 2*). Out-dated and under-sized cubicles may sometimes be adapted to fit bigger cows; *Figure 3* shows some techniques.

The cubicle bed

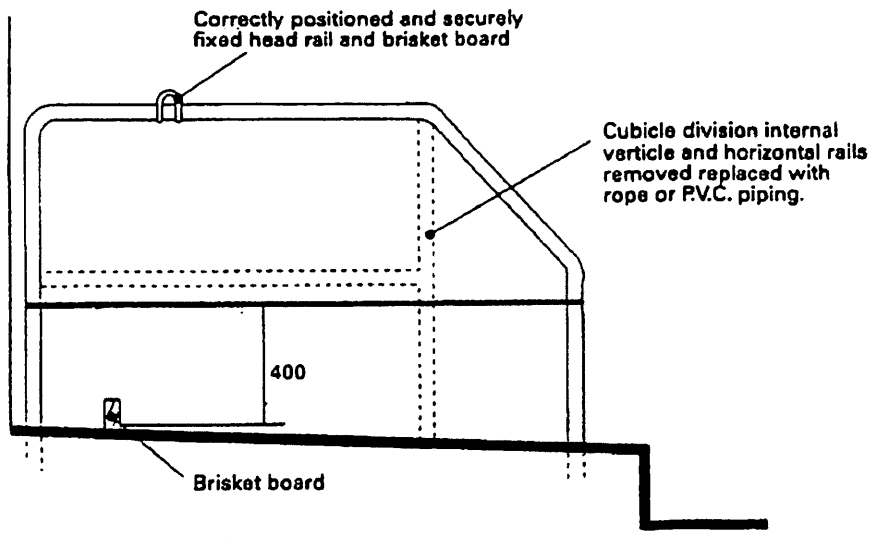
It is a requirement that the base slopes from the front to the back, by around 80 mm, with no lip to impede drainage. This is far from a problem, since cows prefer facing uphill when they lie. The cow benefits from some type of bedding (emphasised by the welfare codes), and it has been said that it can even cope with the wrong dimensions, provided the cubicle is well-bedded. There is a lot of pressure exerted on skin and bone at the knee and hock when the cow changes position. As the cow lies down, it actually 'free-falls' for about 380 mm. Maximum weight, around two-thirds (or more) of its bodyweight, is transferred to the knees when rising. Thus, bedding is very important, especially at *the front* of the cubicle.

The height of the kerb is another important consideration; too high and it can lead to excessive stress, but too low can lead to over-spilling of slurry when scraping out, It should not be greater than 150 mm, and many new cubicles are less than this. Although in some designs wooden kerbs are used, the point to bear in mind is that wood can give rise to disease risk.

The base is very often made of concrete, but sometimes bitumen macadam may be used; this is more expensive, and has been known to lift when the dung dries out on the surface, but it does require less bedding on top. It is best if a dampproof membrane is incorporated in the base construction. *Figure 4* shows some typical construction details.

Bedding materials

Straw is the cheapest material when it is produced on the farm. It is better if chopped, since it becomes bulkier and more absorbent, and it reduces the wastage per cow by up to 25%. It is, however, more hazardous to humans in the chopped state. The bed depth needs



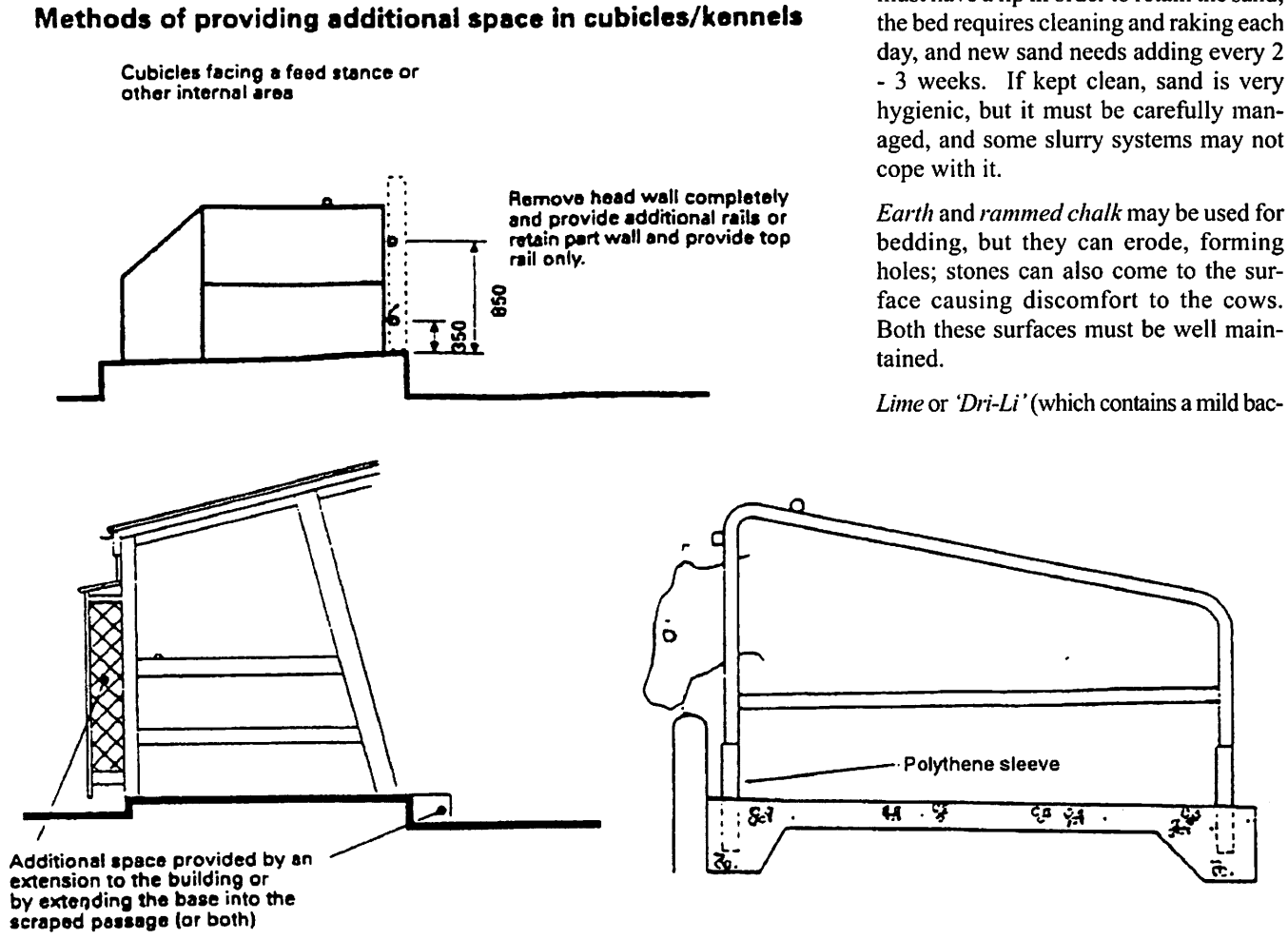


Fig. 3 Cubicle adaptions and conversions (CEM, 1994; SAC)

to be at least 50 mm if the base is concrete, and new straw should be applied 3 times per week. Any fouled straw can be raked into the dunging passage, preferably twice daily. Many experts report that a thick straw bed is just as good as any expensive mat system.

At least one farm has tried retaining a thick layer of rotting straw muck under the cow's knees for when it rises; this makes a good padding which does not move. Apparently, there is no problem of dirty cows and the risk of mastitis is minimal since the muck is at the front of the base.

Woodshavings make a good hygienic bed, but it does work out more expensive than straw. It needs to be 50 mm deep on concrete, and renewed three times per week. *Sawdust* is more absorbent than woodshavings, and very comfortable. One problem with sawdust when damp, however, is that it readily leads to environmental mastitis problems.

Sand is comfortable if the bed is deep enough; it should be at least 50 mm, and some people say 80 – 150 mm is a better depth. A thin coat on wet concrete becomes like sandpaper, and so would be far from comfortable. The cubicle base must have a lip in order to retain the sand; the bed requires cleaning and raking each day, and new sand needs adding every 2 - 3 weeks. If kept clean, sand is very hygienic, but it must be carefully managed, and some slurry systems may not cope with it.

Earth and *rammed chalk* may be used for bedding, but they can erode, forming holes; stones can also come to the surface causing discomfort to the cows. Both these surfaces must be well maintained.

Lime or *'Dri-Li'* (which contains a mild bactericide), for example, may be sprinkled on top of the bedding, at about 100 – 150 g/cubicle/day. This helps to keep the cows dry and assists in preventing mastitis.

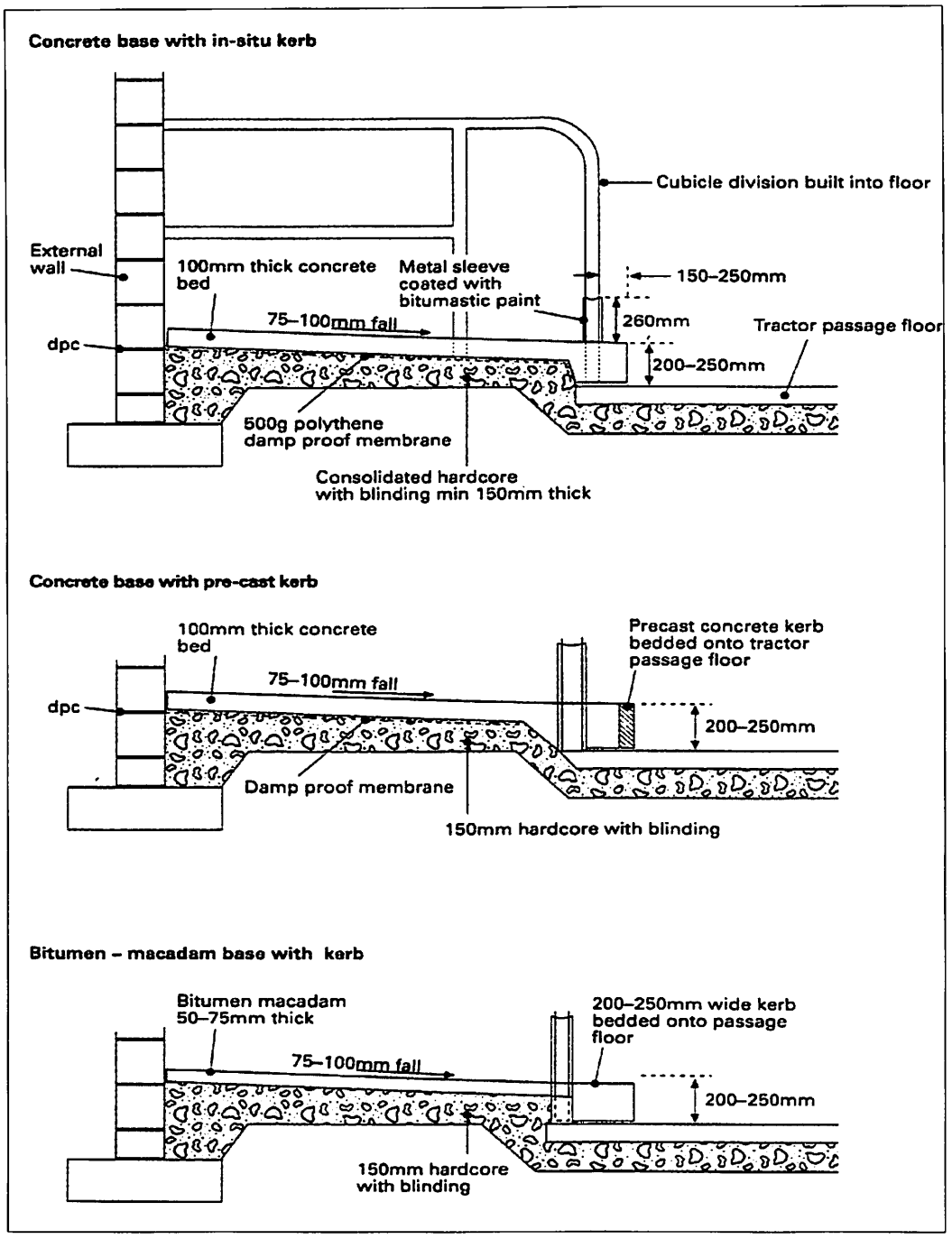


Fig. 4 Cubicle construction details for alternative bases (CEM, 1994).

Cubicle mats/mattresses

These have become popular on some dairy farms, but are expensive at around £25 £60 each. (Companies often offer discount, however, when large quantities are ordered.) Mats must be soft enough for the knee to sink into them without too much pressure exerted, but at the same time, be sufficiently hard to support the hoof firmly. Cows do find them comfortable, and those with the most 'give' seem to be the cow's choice. They are potentially very hygienic, but should be kept dry in order to reduce bacterial growth and reduce feet slipping on them. It is advisable to cover them with a thin layer of bedding (straw or sawdust), to reduce problems. Mats do make a good insulated base for the cow to lie on. Some people report that a dry, interior-sprung cow mat is almost perfect for use in dairy cow housing.

'Enkmatting' cow carpet was fitted at the SAC dairy unit in the late 1970s, and was judged to be partially successful; cow comfort was certainly improved. 'Chopped-tyre mats' are currently being evaluated at SAC; these are 75 – 100 mm thick, but cost over £60 per cow. Dr Mike Kelly at SAC, is continuing research into the design and use of cow mats. *Figure 5* shows the layout of the chopped-tyre mat.

Another option for the cubicle base, is a *bonded synthetic screed* of resilient material on top of the existing concrete floor. This has no joints or seams, and does not have a tendency to move; nor does it harbour dirt or disease. An example is 'Flexscreed', which is a resin-rubber floor screed, and costs around £15/ square metre.

Housing floor surfaces and slurry contact

Since slurry softens the horn of the foot, prolonged contact increases the rate of wear and enhances the risk of damage; in fact, the cow avoids walking in slurry if at all possible. Slurry levels need to be kept low, and scraping should be carried out at least twice per day in cubicle housing. An important point to bear in mind, is that if the cow is stepping out of deep slurry to her cubicle bed, then the risk of environmental mastitis again rises; the udder is more susceptible to infection straight *after* milking, so it is essential to scrape at this time. Reference to welfare codes also confirms that the cow should *arrive* at the parlour in a clean condition.

It has been calculated that an average cow evaporates 15 - 20 litres of water per day from her skin and respiratory tract, and in winter the relative humidity can be close to 100% (Webster, 1993). Therefore, there will be no shortage of moisture around, adding to the waste produced. This further emphasises the requirement for frequent scraping and good ventilation in cattle housing.

The floor surfaces of handling areas should minimise discomfort, distress or injury (Milk Marque, 1996). Thus, it follows that housing floors should be skid-resistant, but at the same time, not too rough.

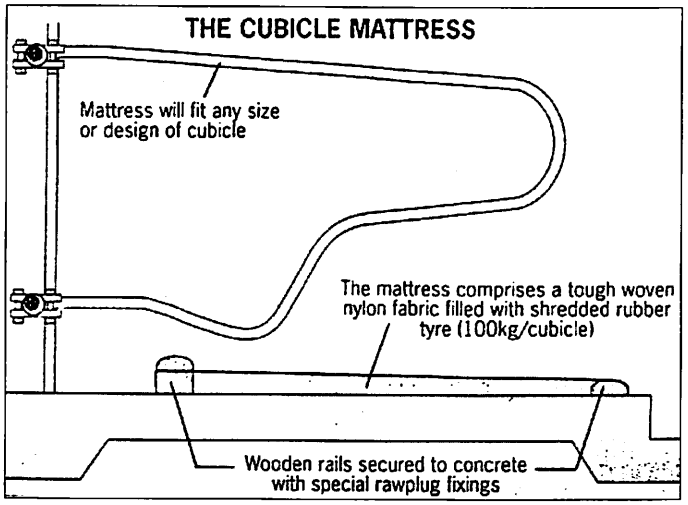


Fig. 5 The chopped-tyre mattress cushions the cows with an inert material that will not breed bacteria (Anon., 1994).

Interestingly, the shear forces on the sole of the cow's foot, when going round a corner, are greater than on smooth concrete than on grooved concrete. However, the risk of cows slipping is patently higher on smooth surfaces. When laying the floor, the correct mix must be used, and it is better to carry out mechanical tamping of the concrete, since this tends to ensure the aggregate is covered by the 'fines' content. Exposed aggregate of hard, sharp-edged stone is obviously not ideal; this situation can often occur with old worn concrete, where loose stones/flints damage the foot. Worn and smooth concrete may be resurfaced, often by cutting grooves 9 mm deep, 10 mm wide and 40 – 75 mm apart in a square/diamond pattern. A grooving machine would be used for this job, and can be hired at reasonable cost. Sand can be also be used to prevent slipping.

Slats for dairy cows are not very popular in the UK, but more than 80% of cows in Holland, Denmark and Ireland are housed on slats. It has been said that slats may be a very effective way to meet the high standard of cleanliness and welfare demanded by the milk purchasers; perhaps we will see more use made of them in the future. There is no space here to look at the detail of slats, but suffice it to say that the dimensions of slats required for adult cattle is 125 mm wide, by spacing of approximately 30 – 40 mm.

Housing for heifers

Most farmers will agree that heifers need special attention when it comes to introducing them to cubicles. They need to be trained to use cubicles (prior to calving), possibly in small groups. Some farms put heifers on straw yards for 1 - 3 months after calving to reduce problems. Depending on cubicle design, many people adjust the size to suit smaller animals, perhaps by moving the headrail, or even by hanging tyres inside the divisions. Heifers standing for long periods tend to suffer from greater problems of haemorrhages in the claw sole compared with mature cows. Very often, heifers are forced to stand for extended times due to conflict and bullying by older cows. Some experts recommend 20 - 25% more cubicles for housing heifers compared with cows to alleviate problems.

Housing layout and space allowances

As a general rule, allow generous space around drinking troughs, collecting yards, entries and exits; avoid sharp bends, protrusions and unexpected level changes. Cows, and especially heifers, need room to be able to flee from other aggressive animals; avoid dead ends with no escape routes, and incorporate sufficient drinking trough space (as a guide, enough for 10% of the herd to drink simultaneously). Lights should be left on at night to allow cows to move freely around. The width of the scraped passageways between the cubicles and feed stance should be 3.2 - 3.5 m in order to allow animals to pass as well as feed. Likewise, the width of passageways between rows of cubicles should be at least 2.4 m. As far as the amount of feed space is concerned, 0.7 m per cow is the allowance, but many advisors say an extra 25% is desirable for feeding silage in order to reduce aggression.

For calculating the room needed for the loafing and exercise yard, 3.3 square metres/cow is the minimum, but 4 square metres/cow is better. Codes of welfare state that cattle must be provided with a total floor space which is not less than 1.5 times the lying area.

When a farm is using computerised out-of-parlour-feeders, it is worth bearing in mind that they often result in cows standing around for long periods of time waiting for their turn to feed. As mentioned earlier, this is not going to be good for their feet.

Conclusion

Cubicle housing, if designed and managed with the cow uppermost in mind, can perform very satisfactorily. On the other hand, if poorly thought out in the first place and/or badly maintained, the structure can have a significant bearing on cow lameness and comfort, ultimately severely affecting production and reducing farm income.

Summarising in general terms, the length and width of the cubicles must be sufficient (otherwise there should be ample borrowing space), there must be a low kerb, and an adequate covering of bedding material. Housing floor surfaces must also be designed and maintained to minimise their effects on cow lameness.

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Principles of traction and compaction

Richard Earl

The aim of this paper is to provide an overview of the main factors influencing the traction (pull) achievable from off-road vehicles and the extent and severity of any resulting compaction damage to soil.

Frequently, the requirements for improving traction (e.g. adding ballast) conflict with those for minimising soil structural damage and, therefore, the optimal situation is often a compromise *(Figure 1)*. In general, it is desirable:-

- to maximise pull by maximising traction developed by wheels or tracks,
- to minimise sinkage and rolling resistance through good flotation, and
- to minimise soil compaction.

1. Factors influencing traction

The magnitude of the tractive force (thrust) achievable from a tyre or track depends on the magnitude of the soil shear force *(Figure 2)*.

This paper was presented at an IAgrE Soil & Water Management Specialist Group Practical Workshop entitled: "Tyres - Traction, Compaction and Selection", held at De Montford University, Caythorpe, Grantham, Lincs, on 11th March 1998. Dr Richard Earl MIAgrE is Lecturer in Agricultural Engineering and Assistant Director of Research, Silsoe College, Cranfield University, Silsoe, Bedford MK45 4DT.

magnitude of the total thrust achievable. A number of factors influence the resistance to shear of each individual portion of soil (Coulomb, 1776; Micklethwait, 1944) and these are illustrated in *Figure 3*. These factors include soil cohesion *i.e.* the ability of soil to bind to itself, the contact area over which soil shear is taking place, soil friction and the normal load (vehicle weight). From *Figure 3*, the relative contributions of cohesion and friction to the overall shear force and hence thrust depend on contact area and normal load respectively.

Sandy and loose dry soils have little cohesion but some friction therefore increasing the normal load will result in greater thrust, however, increasing the contact area (*e.g.* by using larger tyres) will have little effect. Moist clayey soils tend to have high cohesion but little friction and so maximising tyre/track contact area is important on these soils, however, increasing the load will have little effect and may possibly result in reduced pull through greater sinkage and hence an increase in rolling resistance. Moist sandy, loamy and loose clayey soils have varying proportions of cohesion and friction and so a combination of increased contact area and weight should be considered to optimise traction.

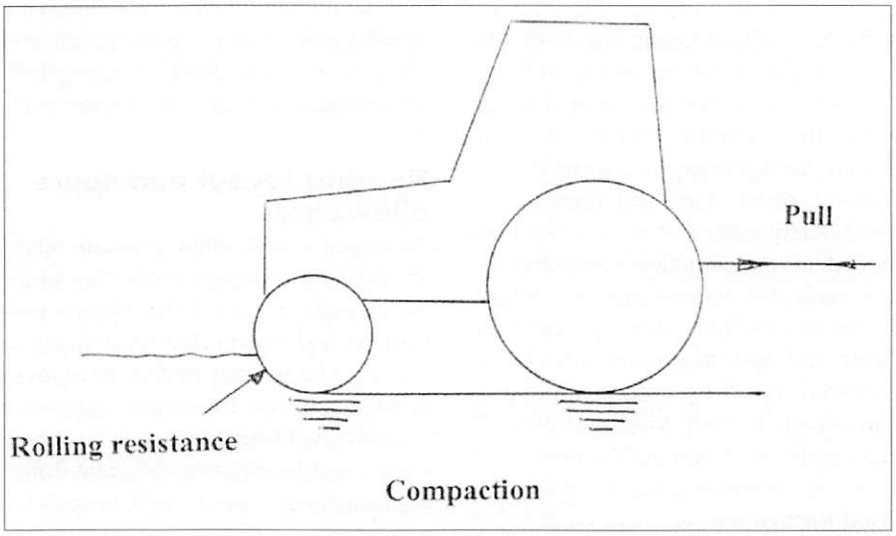

Fig. 1 Conflict between maximising pull and minimising rolling resistance and compaction.

Cleats or grousers create shear planes between discrete portions of soil. The resistance to shear along these individual shear planes contributes directly to the

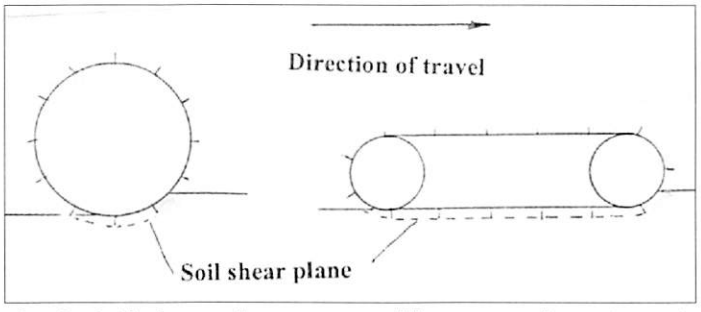

Fig. 2 Soil shear planes created between cleats (tyres) and grousers (tracks).

The amount of wheel/track slip (soil shear)

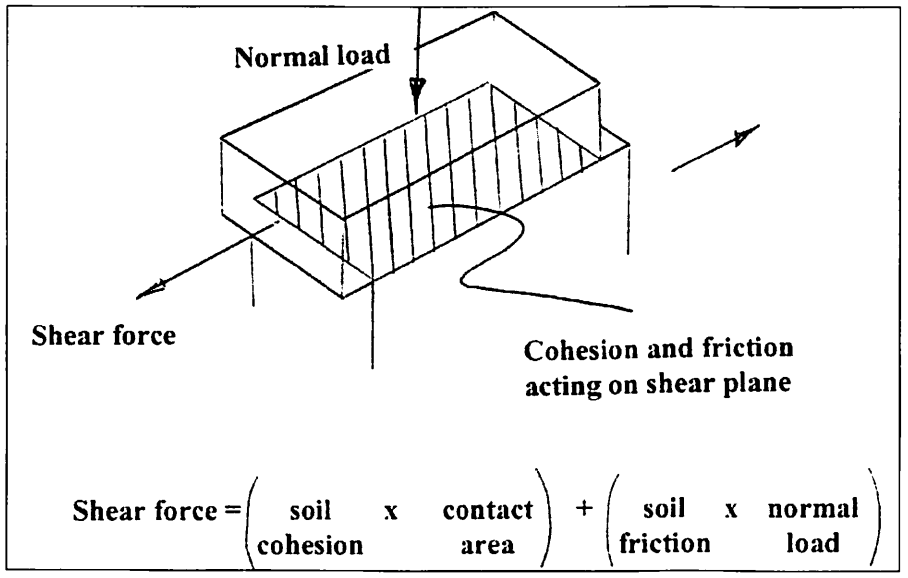

Fig. 3 Factors influencing the resistance of soil to shear.

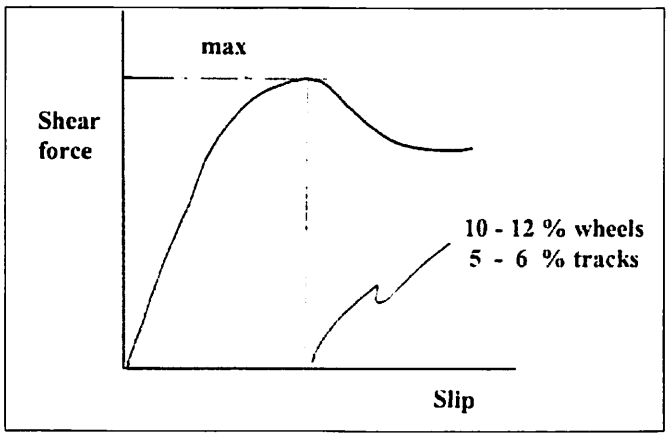

Fig. 4 The influence of slip on the magnitude of the shear force developed.

which occurs affects the magnitude of the shear force, or thrust, achieved *(Figure 4)*. As slip increases, shear force increases until a maximum is reached, beyond which, any further increase in slip results in a reduction in thrust. Some slip is therefore necessary to maximise traction. Optimum slip for a wheeled tractor is typically in the range 10 to 12%, however lower slip (5 to 6%) is optimal for crawlers.

2. Factors influencing sinkage and rolling resistance

The amount of sinkage which occurs during a field operation is dependent on the soil strength, magnitude of the contact pressure (heavy weight on a small tyre of high inflation pressure = high contact pressure) and the amount of slip occurring *(Figure 5)*.

For any soil conditions (strength) it is important to keep contact pressures and slip to a minimum to reduce sinkage. Any sinkage which does occur creates a rut which increases the force required to propel the vehicle across the land. For a given wheel/track contact area, a long narrow contact patch will have a lower rolling resistance than a short wide one *(Figure 6)*.

3. Factors influencing compaction

Compaction is a term used to describe the process of air expulsion from soil under load with a resultant increase in dry bulk density (Earl, 1997). The severity and extent of soil compaction resulting from the passage of an off-road vehicle depends on a number of interacting factors.

- *Soil shear strength* Soils of high shear strength will resist deformation and hence compaction. The shear strength of a particular soil is governed not only by its composition but is strongly influenced by bulk density and moisture status.
- *Contact pressure* The severity of compaction, particularly towards the soil surface, can be reduced by reductions in contact pressure, however, this is commonly achieved by increasing the contact area (*i.e.* bigger wheels of lower inflation pressure) which results in less compaction damage, but spread over a wider area.
- *Weight* The weight of a particular vehicle tends to govern the extent of any resulting compaction which is different to the effect of contact pressure which governs the severity of the damage. The use of four-wheel drive vehicles can be advantageous because all vehicular weight contributes to traction and, therefore, less overall weight is required to achieve a given thrust compared with a two-wheel drive vehicle.
- *Slip* Although a certain amount of slip is required to optimise traction, it can have a detrimental effect on soil through increased compaction and smear.
- *Speed* The higher the speed at which a particular operation is carried out, the lower is the resulting compaction as time during which deformation can take place is reduced. In addition, the power required to carry out the task depends on thrust multiplied by velocity and so the same power can be achieved by increasing the velocity and reducing the thrust requirement. This enables the same operation to be

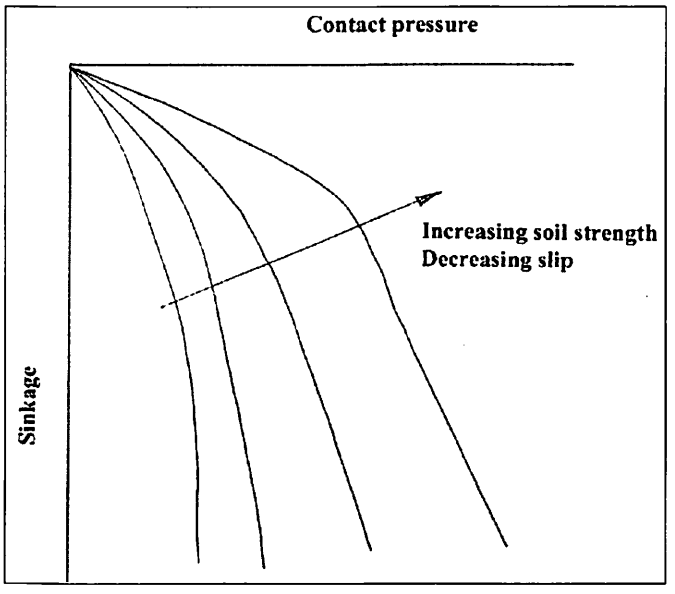

Fig. 5 The influence of soil strength, contact pressure and wheel/track slip on sinkage.

carried out with lower weight and contact pressure and therefore results in less compaction. There are of course practical issues to be considered when exploring this option including driver comfort and quality of the result.

- *Number of wheel passes* The amount of additional compaction resulting from multiple wheel passes decreases with each pass and so there is some merit in using the same wheelings repeatedly.

To summarise, the higher the soil strength and speed, and the lower the pressures, weights and slip, the lower is the risk of compaction damage. For the same contact pressure, increased weight causes the same severity of compaction, but to greater depths.

4. Practical ways of maximising pull whilst minimising sinkage, slip and compaction

Increase weight on frictional soils

- Use weight transfer from non-driven front wheels and weight addition from mounted implements.
- Attach weights to, or water ballast, driven wheels.

Increase contact area on cohesive soils

- Minimise tyre inflation pressure.
- Increase tyre diameter.
- Increase tyre section or track width.
- Fit dual wheels (NB diameters should not differ by more than 15 mm).
- Add cage wheels.
- Fit half-tracks or tracks.

Aim to shear the strongest soil layer

- Use adequate tread or grouser height (avoid excessive penetration to limit soil churning).
- Ensure treads are self-cleaning.

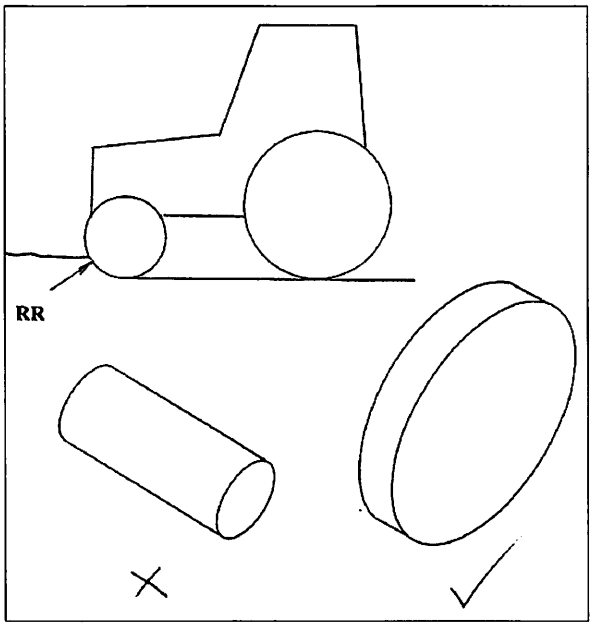

Fig. 6 Sinkage and rolling resistance (RR).

Acknowledgement

The author would like to thank Professor Gordon Spoor for the use of his lecture notes which provided the basis of this paper.

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'Act now' is the advice for Britain's farmers awaiting green light on polythene recycling

Whilst Britain's farmers are still awaiting the green light on a possible new scheme for the collection of waste polythene, one company has issued a timely reminder that there is available today an environmentally acceptable alternative to burning or burying.

Recent publicity has highlighted the continuing talks between the plastics industry, Government and farmers aimed at finding a solution to the problem of disposing of up to 60,000 tonnes of plastics used annually on Britain's farms. Latest estimates indicate a decision around the end of the year.

Meanwhile, Dumfries Plastics Recycling, set up in 1995 to recycle polythene silage film collected through the original nationwide 'Farm Films Collection Scheme', has emphasised that its recovery and recycling facilities still offer one of the most efficient routes to disposing of used farm plastics.

Lance Hamer, Works Director at Dumfries Plastics Recycling explained, 'The original farm films collection service made life easier for the farmer by collecting silage film free of charge direct from his gate. Sadly, the scheme collapsed when polythene film importers undercut the price levels that were helping fund the service. Now talks are under way to develop a new scheme in line with the Government's green policies but farmers need to be aware that our recycling facility is still open and offers a safe option to those who can deliver their polythene films to us.'

Dumfries Plastics Recycling will receive and recycle used farm polythene for a small gate fee. The same quality criteria are applied as under the original scheme - the polythene should be baled before acceptance.

Until a new collection scheme is available, Mr Hamer strongly recommends that farmers send used films directly to Dumfries. 'Farmers are fully aware that burning or burying could leave them open to prosecution. For this reason, we know that many farmers have been building stockpiles of old polythene since the previous collection service collapsed. But there is no reason for not acting now. Simply bale up and ship out directly to our recycling plant. The cost is minimal compared with the risk of prosecution if a farmer is caught burying or burning plastic.'

Dumfries Plastics Recycling is part of the BPI (British Polythene Industries) group, the largest European producer of polythene film for use across all applications including the agricultural sector.

Farmers requiring more information about recycling services offered by the company should contact Lance Hamer on 01387 247110.

Membership Matters

Quarterly The Newsletter of the Institution of Agricultural Engineers Winter 1998

Bio-engineering in Nepal - a joint IAgrE/ICE/TAA seminar

Over 100 members of the three participating organisations attended this highly successful early evening seminar at the elegant headquarters of the Institution of Civil Engineers (ICE) in Great George Street, London on Wednesday 14th October. The collaborative event - the first in a new series - was organised by Rob Petts and Darlene Torey, Appropriate Development Panel members of the ICE and ***Derek Sutton*** *on behalf of the IAgrE and the Tropical Agriculture Association (TAA). A lively question and discussion session followed the fascinating and entertaining presentation by the two speakers a synthesis of which follows.*

Developing an institutional capacity in biological techniques for slope stabilisation and erosion control in road construction and maintenance in Nepal - sharing experiences.

Dr Jane Clark, DFID and John Howell, Living Resources Ltd

The multidisciplinary skills represented by the three host organisations for this seminar provided an excellent audience for a discussion on bio-engineering, as the subject demands collaboration between engineering, natural and social sciences. The seminar aimed to chart the development of bio-engineering in Nepal from experimentation and research to implementation, a period of over ten years between 1986 and the present. The work was carried out by the Department for International Development (DFID) in partnership with the Department of Roads (DOR) of H M Government of Nepal.

The presentation described the process followed in the introduction of bio-engineering in Nepal, which covered three distinct phases: (1) research; (2) project; and (3) capacity building. The purpose of DFID support was to improve the effectiveness of road maintenance throughout the strategic road network, through the protection of hill slopes, embankments and structures from the problems associated with erosion and other types of shallow slope failure.

A form of bio-engineering has been developed which is specifically adapted to the unique environmental, economic and institutional conditions in the Nepal roads sector. After a period of research and experimentation the advantages of bio-engineering were recognised by HMGN and a decision was taken to introduce the technology throughout the main road network and to train engineers and overseers in its regular use.

1) Research phase 1984 - 1991

During the research phase, work focused on the Dharan to Dhankuta Road in East Nepal and the Dauney Hill section of the East - West Highway. The work was undertaken as part of the Transport Research Laboratories UK (TRL) research contract to investigate low cost methods of slope stabilisation. During this period, species which could be used in bio-engineering techniques were identified and their engineering properties classified. Species were classified as fulfilling one or more of six functions (to catch, armour, support, reinforce, drain, or improve the site). In many locations, emphasis was given to techniques which improved slope drainage, on account of the common problems of high infiltration and low cohesion found in the materials which comprise the ridges of the steep Himalayan foothills.

2) Project phase 1998 -1994

The many bio-engineering techniques explored during the research phase were tested and developed and their use expanded over a wider range of conditions. Bio-engineering was included in DFID funded road maintenance projects (notably, on the Dharan Dhankuta Road, Prithvi Highway and the East - West Highway) as part of routine maintenance. To ensure the techniques would be replicable over a wide range of conditions the more intricate ones perfected during research were abandoned or modified in favour of simpler, more robust techniques. The species list was rationalised to include only those plants which could easily be propagated in the vast numbers required and were robust enough to recover from damage (grazing damage or soil slumps and minor rock falls). During this period the importance of careful site assessment emerged as a key requirement for success in applying the techniques for slope protection or stabilisation. It became apparent with experience that any one slope would require a number of different techniques according to the erosion processes acting on the site. Attention to

continued overleaf

detail and observation is critical. DOR and DFID produced the first bio-engineering manual for Nepal in 1991. This manual helped to promote the techniques and share the lessons learnt with a wider audience.

3) Capacity building 1994 - 1999

The expansion of bio-engineering from a narrow research activity to a wider experimental setting within projects provided the DOR with evidence of its potential effectiveness. Experience demonstrated that bio-engineering had the potential to make a significant contribution to the increased effectiveness and reduced cost of road maintenance. It had the added attraction that vegetative techniques only depended on the use of local materials and skills, all readily available at low cost.

In 1994 an opportunity arose for DFID to strengthen support for the development of bio-engineering within the DOR. This would expand and develop bio-engineering as a nation-wide capability. As part of a larger package of support to the DOR, DFID funded the establishment of a Bio-engineering Unit within the Geo-environmental Unit. The remit of the Unit was to introduce and ensure sustainability of bio-engineering technology. The key approach used in the capacity building stage was to work with the strengths of the DOR and to use its broad reach and widespread network of engineers throughout the country. This expansion was supported by an intensive training package which, over a three year period, trained all the overseers and engineers in the DOR in addition to private sector engineers. The detailed curriculum for the training formed the basis for a Bio-engineering Manual for Nepal (see below). The involvement of a wider range of policy and decision-makers, as well as staff at the University and in other government departments helped to build up a strong interest in the new approach. Standards and guidelines were agreed for the specification of bio-engineering construction methods. This allowed DOR engineers to place bio-engineering contracts with small-scale contractors. Several supporting studies were commissioned by the unit, which further developed the understanding of bio-engineering. Among these were a study of road side users and their involvement in road side vegetation management and a study which identified options for the maintenance for mature vegetation on road sides.

The preparation of a comprehensive Bio-engineering manual is now underway and is due to be completed in early 1999. It will be presented in two volumes: (1) a field guide for use on site and (2) a manual which covers the principles of bio-engineering in Nepal. This Manual will be unique because it is being written specifically for Nepal and draws on over 10 years of practical experience and learning.

For more information please contact:
Jane Clark, DFID 94, Victoria Street
London SW1E 5JL
(j-clark@dfid.gtnet.gov.uk)
or John Howell, Living Resources Ltd,
Durnstons Field, Heath House,
Wedmore, Somerset
(Living_Resources@compuserve.com)
or Derek Sutton
(derek.sutton@bbsrc.ac.uk).

Web site development

Progress is now being made with both the IAgrE and EurAgEng web sites.

The Institution was fortunate in having assistance with the design of the original sites from Colin Watt at Silsoe College and Prof Francis Sevila of Agro, Montpellier with the assistance of their students, for which we are most grateful.

Both sites have now moved 'in house' and are re-established at http://www.iagre.demon.co.uk and http://www.eurageng.demon.co.uk, respectively.

We shall now ensure that the sites are regularly maintained and that the content is gradually augmented so that they become an increasingly valuable and topical source of information about the two societies to both members and those considering joining.

Lyndon Eric Hughes

Lyndon Hughes, much loved father of Phillip and James and husband of Janet, died in early July following a long and bravely fought illness.

I first met Lyndon when he came to work at Warwickshire College of Agriculture in 1983. He quickly progressed from a part-time instructor in welding to a Lecturer in Agricultural Machinery and later a Senior Lecturer covering a whole range of subjects including environmental studies.

He had an unusual upbringing in as much as he didn't attend school until he was caught by the school attendance officer when he was about 10 years old. This was a tale he often told us and one could not help but laugh. Lyndon had a way with words and a subtle humour that always brought merriment to the dullest situation.

Despite his lack of schooling, Lyndon did not stop studying whilst at Warwickshire College and he succeeded in gaining an Open University degree. A few years ago he was awarded the Warwickshire College special award for a past student making outstanding progress in his career.

Lyndon served on the West Midlands Branch Committee from 1983 until 1994, holding various positions such as Branch Treasurer, Honorary Secretary, Information Officer and finally Programme Secretary. He was a stalwart of the Branch and it was only when he started to become ill that he had to reduce his commitments.

I remember taking Lyndon out last September to visit a fruit farm and, despite being in considerable discomfort, he managed to show great interest and ask technical questions. Earlier this year he even came back to College (between treatments) and ably assisted me in an area with which he was not over familiar. He was well liked by staff and students and everyone who knew him in the Institution.

He will be sadly missed.

Michael Sheldon, Branch Secretary

About the Forestry Engineering Specialist Group

The Group evolved from within IAgrE and was inaugurated on 15 March 1989. A Committee was formed with a member to represent various aspects of Forest Engineering. The aim of the Group is:

'To represent the interests of Forestry Engineering and exchange information with all professionals in Forestry.'

We have created a forum for engineers and their associates who work and share an interest in the forest industry to meet and exchange their experience and knowledge. This includes outings, meetings and publishing papers. We organise single day Symposia on special subjects which are a current focus within the industry.

We have become responsible for about 100 papers over the last 9 years, covering a variety of subjects from whole tree mechanised harvesting and low cost road construction, to prevention of pollution during forest operations. These papers represented the current thinking of our sector of the industry in the UK.

Our membership of the Institution of Agricultural Engineers provides an avenue of contact with the other land based industries which gives us a broad base not enjoyed by other professional forestry bodies. The Institution offers associateships for our non-engineering colleagues. This provides full membership benefits without being a member of Engineering Council.

One of our most important aims is to have a degree course in Forest Engineering available by the year 2000.

'A Forest Engineer is someone who applies the principles of engineering in the forest industry.'

They are generally confined to Civil, Mechanical and Processing. They are involved in road and bridge building, machinery design and management and, at the processing end, pulping, sawing and board making.

The Forest Engineer will never displace the Forester but, in the future, they will work together, each using his or her special skills, with either an engineering or biological emphasis, to manage the ever changing forest industry to achieve the current goals. The Forester will provide the expertise to develop the resource and the Forest Engineer will provide the expertise necessary to develop the infrastructure and processing systems required to convert the tree to timber products for the market place. Together, and with other specialist professionals, they will plan, harvest and manage multipurpose forests to the benefit of owners, the public and the environment.

Our objective is to facilitate a healthy, multi-purpose, forest industry supported by its own multi-faceted professionals. We will invest in training and become the central source of information on Forest Engineering matters. We hope to produce enlightened managers for the future who will take this growing industry to secure profitability and environmental excellence.

Geoff Freedman, F E G Secretary
Email: geoff.freedman@forestry.gov.uk
Tel: 01721 720 448 Fax: 01721 723 041
Forestry Engineering Conference web site: http://www.unb.ca/web/feroads/main.htm

Rodney Brice-Baker

Rodney Brice-Baker (73) died from a heart attack on the 21 October 1998 whilst on holiday in the USA with his wife Gill having achieved his ambition of flying over the Grand Canyon on his birthday. The funeral at St Thomas's, Lymington was attended by approximately 200 persons including family, work colleagues, customers, suppliers, competitors and representatives of several organisations Rodney had actively supported.

Rodney had spent his lifetime in Agricultural Engineering and in 1970 founded Brice-Baker & Co Ltd the Grain Storage Specialist and although retired remained Chairman until his death. Rodney genuinely believed the only way to conduct business successfully was by respecting and appreciating customers and offering quality products and good service. Rodney was a strong family man and will be greatly missed by his wife and family.

Engineering Council registration

Members will be aware that new Engineering Council regulations (SARTOR 3rd Edition) will be introduced progressively from September 1999.

One of the first effects will be that HND and BSc/BEng Honours qualifications in engineering will not provide complete exemption from Stage 1 Incorporated Engineer or Chartered Engineer.

There are a number of Institution members with these qualifications who have not thought fit to register with the Engineering Council. At this stage, we suggest that they should consider whether registration would be valuable to them at any time in the future. If so, then they should take steps to register at Stage 1 during the next few months. The object of this will be to allow them to obtain Stage 1 exemption and to complete stages 2 (Industrial Training) and 3 (Responsible Experience) at some time in the future.

If this opportunity is missed, then additional study will have to be undertaken before registration at Stage 1 Chartered Engineer or Incorporated Engineer can be obtained.

If you need advice please contact either the Secretary or Membership Secretary.

Chartered Engineers and Incorporated Engineers – a comparison

SARTOR 97 increases the standards for registration as a Chartered Engineer (CEng) or Incorporated Engineer (IEng). In particular, Incorporated Engineers now need an accredited three-year degree or equivalent qualification so that, in future, there will be two kinds of graduate professional engineer.

As a result, the question is frequently and increasingly asked: 'What is the differënce between CEng and IEng?' SARTOR itself describes the differences in considerable detail but, for many purposes, a shorter and simpler comparison is useful. The brief definitions given below are followed by a chart which outlines the typical job roles and responsibilities of CEngs and IEngs. This has now been approved by the Registration Standards Committee of the Engineering Council. The respective accredited degree courses and the subsequent initial professional development of individuals should fully reflect the aims embodied in the comparison.

Any queries and comments on the chart may be addressed to the Director for Engineers' Regulation at the Engineering Council, 10 Maltravers Street, WC2R 3ER (e-mail: staff@engc.org.uk).

Chartered Engineer

Chartered Engineers are concerned primarily with the progress of technology through innovation, creativity and change. They develop and apply new technologies; promote advanced designs and design methods; introduce new and more efficient production techniques and marketing and construction concepts; and pioneer new engineering services and management methods. They may be involved with the management and direction of high-risk and resource intensive projects. Professional judgement is a key feature of their role, allied to the assumption of responsibility for the direction of important tasks, including the profitable management of industrial and commercial enterprises.

Requirements:

4 year accredited MEng degree
or
3 year accredited BEng(Hons) degree plus
1 year postgraduate learning (Matching Section)
and appropriate Initial Professional Development (training and experience) followed by a Professional Review with Interview

Incorporated Engineer

Incorporated Engineers act as exponents of today's technology and, to this end, they maintain and manage applications of current and developing technology at the highest efficiency. Incorporated Engineers require a detailed understanding of a recognised field of technology, so they can exercise independent technical judgement and management in that field. They provide, independently and as leaders, a significant influence on the overall effectiveness of the organisation in which they work, often in key operational management roles.

Requirements:

3 year accredited engineering degree
or
2 year Higher National plus
1 year additional learning (Matching Section)
and appropriate Initial Professional Development (training and experience) followed by a Professional Review with Interview.

Two Types of Professional Engineer

Different but of Equal Value

All Professional Engineers must:

- make a personal commitment to live by the appropriate code of professional conduct, recognising obligations to society, the profession and the environment
- utilise effective communication skills - oral, written and electronic
- undertake Continuing Professional Development

Chartered Engineer	Incorporated Engineer
KNOWLEDGE / UNDERSTANDING LED But needs appropriate know-how	KNOW-HOW LED But needs appropriate knowledge / understanding
Top class innovative engineering - technical and managerial leadership	Top class applications engineering - Independent judgement within field
Mathematical modelling - understanding of theory & IT	Application of appropriate maths, science , IT
System orientation (e.g. synthesis of options for design and continuous improvement	Detailed implementation of today's knowledge (e.g. design, manufacture, marketing of products),
Pure and Applied Research and Development	Comprehensive quality assurance of products and services
Designing beyond limits of current practice	Developing cost-effective systems and safe procedures
Cultivating medium and long-term perspective	Cultivating short and medium-term perspective
Team and resource management - prospective promotion to middle / top management	Team and resource management - possible promotion to middle / top management

Overlap in Mobility and Employment

Call for massive sustainable development programme

At the AGM of Architects and Engineers for Social Responsibility (AESR) in London on 17 October 1998, there was a call for a massive global programme to both limit environmental damage and minimise the effects of the present economic crisis.

The Chair of AESR, Martin Quick, said that many of the world's present problems were interacting on each other. Reductions in productive agricultural land and in fresh water supplies which are likely to result from climate change affecting some of the world's most tense areas, such as the Middle East and the Indian sub-continent, could exacerbate conflicts there. A shortfall of oil production in relation to potential demand that is probable early next century is also likely to be a cause of conflicts.

He said that, as energy production was the biggest source of greenhouse gases, major improvements in energy efficiency would reduce these problems. Money spent on this sort of activity would be more effective in leading to genuine security than massive expenditures on military defence.

Many of the countries now most affected by the economic crisis, such as Thailand, Indonesia and Brazil are where major damage is being done to tropical forests, leading to loss of bio-diversity and adding to emissions of greenhouse gases. In the former Soviet Union, pathetically inefficient energy systems lead to unnecessary pollution, and again contribute to climate change while many people shiver in the winter.

A massive, carefully targeted programme of sustainable development projects in these countries and elsewhere would both provide a boost to the world's economy, and be an early down-payment towards achieving the huge reductions that are needed in greenhouse gas emissions. Funding could come from credits from an international organisation (a global version of the American New Deal of the 1930s) or from a very small tax on the massive global capital transfers which have been part of the cause of financial instability. In the case of Russia, which has asked for food aid from the EU, this could be used to finance environmental improvements while helping farmers here.

The energy and resource conservation theme of the AGM was continued in the talk that followed by Bernard Hunt of Hunt Thompson Associates, the architects for the Millennium Village at Greenwich. This will provide housing with a very high level of energy efficiency, and opportunities for materials recycling, serviced by good public transport, and geared into the information technology opportunities that are becoming available. Of equal interest were the proposals for giving residents greater control over their environment than is usually the case in a development of this kind.

AESR believes that the technology to achieve a high quality of life for all is available - architects and engineers can help to deliver this, but the politicians must set the framework so it can happen on a global scale.

Contact: **Martin Quick - tel: 01453 76455**

Membership movements

Mem No	*Name*	*From*	*To*
6524	P W Amos	Scotland	Tyne and Wear
6675	N Bashir	Bedfordshire	Surrey
5619	R A Boak	West Sussex	Shropshire
4654	C G Brown	Cambridge	Surrey
6679	V W J Brown	Northern Ireland	Tyne and Wear
5957	S W E Butler	Oxfordshire	London
5430	K O Dunnett	Cambridge	Bristol
6332	J P Emery	Kent	Northamptonshire
6668	G M Gillespie	Bedfordshire	Ireland
6516	T Gyamtsho	Bedfordshire	Bhutan
5711	D N Kilshaw	Lincolnshire	East Sussex
6558	A M Lawson	Cheshire	Essex
6366	K C Leung	Northumberland	Hong Kong
6164	K W Priddle	Devon	Somerset
5010	D J Roe	Hertfordshire	Lincoln
5387	S J Scoones	Lancashire	China
5352	A R Scott	Gloucestershire	Kent
6528	K R Scrivens	Worcestershire	Gloucestershire
4963	J A C Steel	East Sussex	Namibia
5070	R P Stock	Bristol	Norfolk
2132	R Streatfield	USA	Lancashire
2707	P H Walker	Buckinghamshire	Surrey
6721	J Wange	Bedfordshire	Uganda

Gone Away

Name	*Last known address*
Warren Bowden	4 Church Hill Cottages, Kersey, Suffolk, IP7 6EE
Simon Ngwane Fonebi	58 Catherine Street, Reading, RG30 2DJ
Alfred Tcherbi-Narteh	63 Gooch House, Kenninghall Road, London, E5 8DQ

Institution membership changes

Admissions – a warm welcome to the following new members:

Member
D Nancoo (Canada)

Associate Member
M J Bignell (Leicestershire)
B Cusworth (Shropshire)
S D Gamble (Northamptonshire)
M R Geary (Hampshire)
J E Holmes (Lancashire)

Associate
G M Kapata (Zambia)

Student
R J Craven (Derbyshire)
I M MacKinnon (Inverness)
R W Pick (York)
T I Stacey (Powys)
A J Watts (Bedfordshire)

Readmission
M C Thorne (Warwickshire)

Transfers – congratulations on achieving a further phase in your professional development:

Member
J E Fox (Kenya)
I M Hunt (Gwent)
Y Persaud (Guyana)
M J Thakoordin (Guyana)
S W Wilcox (Wiltshire)

Associate Member
V W J Brown (Tyne & Wear)
W J Davies (West Midlands)
R G Donald (Oxfordshire)
P R Earl (Norfolk)
K J Eatough (Bedfordshire)
I M Fenton (Oxfordshire)
M J Oliver (Bedfordshire)
S Woods (Leicestershire)

Associate
N Bashir (Bedfordshire)
J M Bellarby (Carmarthenshire)
E Davidson (Norfolk)
I J Day (Essex)
C S Findlay (Berwickshire)
S W Fletcher (Cambridgeshire)
N A L Gunn (Bedfordshire)
T Gyamtsho (Bedfordshire)
R T Ingram (Essex)
H B Leyendecker (Tyne & Wear)
A Margiwiyatno (Bedfordshire)
A S Nyirenda Jnr (Gloucestershire)
D Price (Caithness)
G D Price (Powys)
S C Scott (Tyne & Wear)
E F Stephenson (Lancashire)
L N Storey (Shropshire)
B Suffield (Leicestershire)
R T Vaughan (Bedfordshire)
C H A Young (Surrey)

Deaths – with great sadness, we record the death of:
C J Dewell (Kent)
A I Munns (Cambridgeshire)

Engineering Council

Registrations

CEng
L U Opara (New Zealand)

IEng
I M Hunt (Gwent)
S W Wilcox (Wiltshire)

EngTech
M C Thorne (Warwickshire)

Survey points to strong support for reshaping proposals

Proposals aimed at reshaping the engineering profession in preparation for the new millennium are broadly supported by the UK's professional engineers, a new Engineering Council survey indicates. The proposals are currently being considered by the profession through a consultation exercise involving the 37 engineering Institutions.

The 4,500 randomly selected, registered engineers who responded to the survey questionnaire were asked to give their views on three ideas aimed at raising the profile of engineers and engineering:

- a National Marketing Campaign to promote UK engineering
- the adoption by Chartered and Incorporated Engineers of the word 'Engineer' as a prefix title (as Doctor is used by medical practitioners)
- voluntary licensing for certain prescribed engineering operations.

There was support from an overwhelming 92 per cent to the suggestion that there should be an advertising-led National Marketing Campaign aimed at changing the public perception of engineering and promoting it as a creative and stimulating career. Most respondents 'strongly supported' this proposal.

The proposal that the word 'Engineer' be adopted as a prefix title for registered engineers at Chartered and Incorporated level was supported by 63 per cent of respondents, with 32 per cent strongly in support.

There was 54 per cent backing for a proposal for the certification, and periodic re-certification, of the professional skills of registered engineers in prescribed areas of work - although only one in seven strongly supported this particular proposal.

The survey was carried out independently for the Engineering Council by Electoral Reform Ballot Services. The response rate of nearly 47 per cent is considered high for a survey of this type.

News of Members

Richard Boak has moved to Shrewsbury to be UK Operations Manager for Water Management Consultants Ltd, which is an international group specialising in water resources and supply, mining hydrology, and water-related environmental issues. The group has offices in the USA, Chile, Peru, Australia, and the UK. The UK team is particularly strong in water resources, groundwater modelling and hydrogeological problem solving.

Richard has 18 years of experience in the UK and overseas (particularly Africa), in agricultural engineering, hydrogeology, groundwater resources and rural development. He can be contacted on: 01743 231793.

Stephen Scoones who works for Novartis Seeds, moved to China in August where he is to set up an agribusiness joint venture in Shandong Province.

Dr Andrew Landers has moved to Cornell University in the USA to take up a position as a pesticide application specialist, with responsibility for advisory, research and teaching across the state. He says that he is settling in well, but at first it was very strange living in a new country where he has discovered that many things are done in a different way to that in the UK.

He has found a house, 13 Cardinal Drive, Appt. 2, Ithaca, NY 14850, Tel: 607 266 0517. It is a two bedroom duplex and is situated just outside the campus about 2 miles from his office in a street but with woods at the bottom of the garden. The area is stunningly attractive with the eleven finger lakes and many deep gorges and waterfalls. A large area of the State is wooded, leaving the remaining areas for intensive agriculture. New York City and Toronto are about 5 hours away. He says that he is considering buying a small aluminium boat so that he can explore the lakes. There are many vineyards and quite a few people make their own wine, so there is plenty of wine tasting to do.

Andrew says that the job is going well and he is enjoying the challenge. He has spent a lot of time visiting farmers and seeing their crops. He has responsibility for vineyard, orchard, vegetable and turfgrass pesticide application equipment. Andrew says that the farmers are just like those in the UK, some good, some bad. The sprayers vary from 30 year old machines with original nozzles to new GPS self-propelled vehicles. Everyone in the department has been most welcoming and hospitable. There are 18500 students at the University and about 3500 at Ithaca College, a local music and arts college. Sport is a big concern for some, with football and ice hockey being the main past times. There is a single rugby team which he is hoping to support.

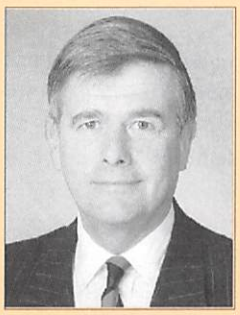
Keith Dunnett, who now has three children, has decided on a complete career change. He has moved to Bristol where he is to spend 2 years at college training to be a vicar in the Church of England.

Erroll Coles has moved from Indonesia to South Africa where he is hoping to obtain some consultancy work. However, he says that due to various regulations, firms are reluctant to take on new staff at senior and consultant level. As some sugar estates are being rehabilitated, he is hoping to find some work in this area. In the past, Erroll has worked on sugar development but has lost contact with the various companies that he was involved with 20 years ago, and it is difficult to make contacts with new people.

Tony Chestney

Raising the public profile of engineers

Malcolm Shirley,
Director General, Engineering Council



On this, my first occasion of contributing to your Institution journal since becoming Director General of the Engineering Council, I sense that the profession is facing a period of considerable challenge and great opportunity. The biggest challenges are to raise the public profile of engineers and engineering, together with ensuring that more young people of the highest calibre choose engineering as a rewarding career. Arguably, the opportunity to achieve this is greater than ever before.

Both of these objectives are inter-linked, of course, and it is clear that no single organisation on its own can successfully bring them about. It is only by combining resources that we in the profession - and the wider engineering community - can hope to succeed. The best way to achieve this is with unity of purpose and clear dialogue, particularly between the Engineering Council and the professional Institutions which it serves.

After nearly three years in its present form, I believe that I have taken over an effective Engineering Council that is able to make an extremely positive contribution. I feel privileged to be the beneficiary of what was achieved by my predecessor, Mike Heath, who did a great deal to establish the new Council and its staff, culminating in recognition as an Investor in People this summer. He also did much to develop the Council's

partnership and working relationships with the professional Institutions and other organisations, relationships which we now need to consolidate and develop. We are currently also finalising the Council's new strategy for the future, as well as refining our activities and processes to maximise the focus and cost-effectiveness of the services we provide to registrants.

One of the main achievements of the Council has been to ensure that the voice of the profession is heard and its influence developed at a national level, in government and at Westminster. It was a major achievement for the Council, as the lead body for the whole of the profession, to agree with Government the Memorandum of Understanding that has enabled engineering to make an increasingly valuable contribution to the national decision-making process. With the specialist lead of individual engineering Institutions, the Council is now able to put the profession's responses to a wide variety of pertinent consultation documents that form a key part of the legislative programme. This is just one of the goals of the Council as, with its partner Institutions, it addresses many of the long-standing concerns of engineers, including better recognition of their status and their contribution to everyday life.

If the British economy, both industry and commerce, is not to face damaging skills shortages, the profession must ensure that not only are the best youngsters attracted to engineering, but that their education and training are second to none in order to prepare them for what undoubtedly will be a world of increasing technological emphasis and challenge. This is why raising the profile of engineering and ensuring the profession is widely recognised as an exciting and well-paid career are so essential.

There is a full agenda of proposed and committed programmes to demonstrate engineering's contribution to national wealth creation and the well-being of the public. The most far-reaching if these is the proposed National Marketing Campaign, which is being developed by a major communications agency for a joint venture partnership comprising the Engineering Council, the Engineering Employers' Federation and the Engineering and Marine Training Authority. This campaign will use the power of television commercials and other national advertising to target young people and those who influence them. It is planned to be long-term - but its success will depend upon the strong support of industry.

Driving these initiatives is the realisation that, for UK engineering to remain world class, the brightest and most talented of children and students must be fired with the challenge and excitement of what an engineering career can offer. Importantly, these major new initiatives are receiving the backing, not just of the profession, but of the broader engineering community. This is as it should be, because employers, consumers and society in general will be the ultimate beneficiaries.

The Quinco campaign, which is committed to co-ordinating the promotion of engineering for the next five years, has in the short time since its formal launch this summer attracted support from some of the major industrial companies - as well as receiving endorsement from the Government. Part of what Quinco is aiming to achieve, through a range of projects across the UK, is to change many of the incorrect perceptions of engineering that have become culturally ingrained. That too is the target of the National Marketing Campaign, which is included in the Quinco project portfolio.

The Engineering Council is additionally exploring a range of proposals to increase awareness of the role and contribution of registered engineers, and these are being discussed with the Institutions. Principal among these are voluntary schemes of licensing for individual engineers in prescribed areas of work, particularly in activities with a health and safety or risk element. We have also suggested that Chartered and Incorporated Engineers have a prefix 'Engineer' title, as medical practitioners use 'Doctor'. These concepts are being developed in conjunction with the professional Institutions.

Evidence that the changing skill needs of industry and business are being addressed is found in many areas of the profession. One example is the Standards and Routes to Registration (SARTOR) policy document that recognises that many of today's engineers require a broader education and should be trained in applying the latest technologies to find creative business solutions.

There will continue to be a place for engineers more at home with applying theoretical knowledge, but the priority is for the more practical breed of professional, in the form of the Incorporated Engineer.

Which returns us to meeting the needs of industry and business. With a stronger emphasis in the formation process on vocational subjects in higher education, we can ensure that there are increasing opportunities for young people with aptitude to equip themselves with the skills that will be demanded by industry and business.

What is clear is that the organisations which have a concern for the maintenance of UK engineering as a world-class profession are not sitting back, but are making a significant effort to bring about change. This is not only a task for the professional bodies, however, but also for individual engineers. I firmly believe that it is up to all of us to make our own contribution to improving the public perception of our profession. The best way to achieve this is to stop moaning about status and recognition. Engineers have higher average salaries, higher representation in top jobs and lower unemployment than many believe, and the Council's recent research underlines this. Our status in many ways is as high - or as low - as *we* think it is, and if we hold our heads high, people will take more notice of us.

Produced by: Land Technology Ltd, Edinburgh

Printed by: Barr Printers, Glenrothes

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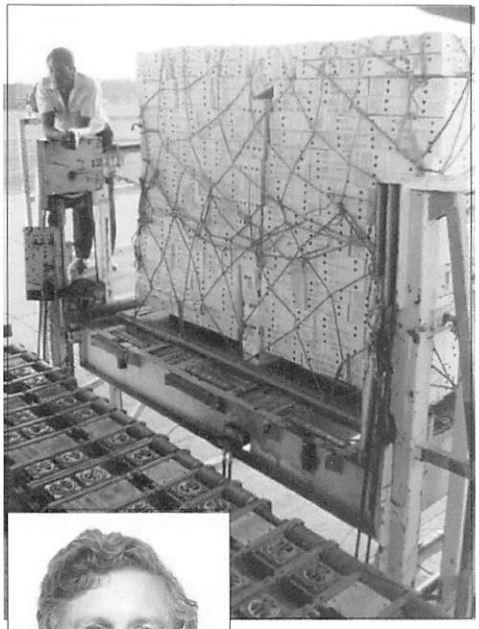
Airfreight of perishable products



Christopher F H Bishop

Abstract

The typical temperature profiles achieved in the airfreight of perishable products indicate not only a lack of temperature control but also insufficient initial cooling of the consignment. The potential areas of difficulty are seen as lack of temperature monitoring, high temperatures on arrival at the airport, poor facilities and/or management for cooling and holding, freight handling and transfer and the lack of temperature control during the flight. The potential use of temperature time indicators as well as insulated and refrigerated containers are discussed.

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1. Introduction

The world-wide growth of airfreight of cut flowers, fruit and vegetables has continued for a number of years. British Airways, one of the top ten carriers, now handle over 31,000 tonnes per year and estimate that throughput is increasing by 10% per year. The global air freight volume for fruit and vegetables was a total of 726,000 tonnes in 1990 and it is suggested that by the year 2000 this will have reached an annual total of 1,325,000 tonnes (Hastings, 1996). The most important crops that airfreighted are cut flowers, foliages, high value vegetables (beans, asparagus and mangetout) and strawberries, with the area of freshly prepared fresh product becoming more important. Although precise statistics on overall quantities of airfrieght are not kept, it is thought that in volume terms cut flowers would be the most important crop. Table 1 shows the increase in airfreight of cut flowers from selected countries to Europe, 1991-95 almost all of this trade was by air.

Although few temperature records are published there is every indication that temperature 'control' in most cases with airfreight is poor. In many cases this lack of temperature 'control' is thought to be because there is a feeling that as an air flight is only a short period of time it is not worth bothering about. Little temperature monitoring actually occurs. There have been very few attempts to monitor actual weight loss but with crops such as asparagus or mangetout there is around a 3.5% weight loss per 24 hours per millibar vapour pressure deficit (Sastry, 1985).

Although some aircraft have holds that can be temperature controlled, the control equipment is seldom used, the control systems are not too precise, and there can be conflicts in the temperature requirements in a mixed cargo flight.

2. Methodology

Over the last three years, a number of air freight consignments have been monitored for temperature. Small single channel temperature loggers, the size of a roll of film, have been inserted in marked boxes of produce at the farm or

Table 1 Imports of cut flowers into the European Union fresh and dried cut flowers* - 1991/1995 in 1000 ecu.

Country of origin	*EU imports of cut flowers, 1000 ecu*				
	1991	*1992*	*1993*	*1994*	*1995 (EUR 12)*
Israel	94,576	96,031	94,475	109,661	107,578
Columbia	75,090	90,215	95,048	88,153	84,735
Kenya	37,752	43,455	51,873	65,889	73,798
Zimbabwe	12,579	22,042	23,879	27,721	35,904
Ecuador	3,436	6,222	10,235	15,105	21,334
Thailand	25,707	25,265	22,498	20,735	19,885
Canaries	12,850	10,791	8,773	9,902	10,560
Turkey	9,723	9,825	10,430	10,678	9,552
Morocco	10,506	11,087	10,083	9,162	9,471
S Africa	8,337	8,033	7,997	7,637	8,125
Zambia	1,297	1,835	2,438	3,422	4,394
Peru	5,496	5,916	2,712	3,086	3,707
Costa Rica	751	1,953	2,392	2,847	3,573
India	507	410	553	1,580	3,523
Tanzania	339	826	1,157	2,285	3,163
Malawi	95	520	814	1,297	2,079
Australia	2,112	2,181	2,065	2,589	2,053
Brazil	3,379	3,542	3,512	2,487	1,994
Uganda	10	0	16	1,017	1,967

Source: Anon., 1997
*in 1995 99% were fresh flowers, 1% dried flowers

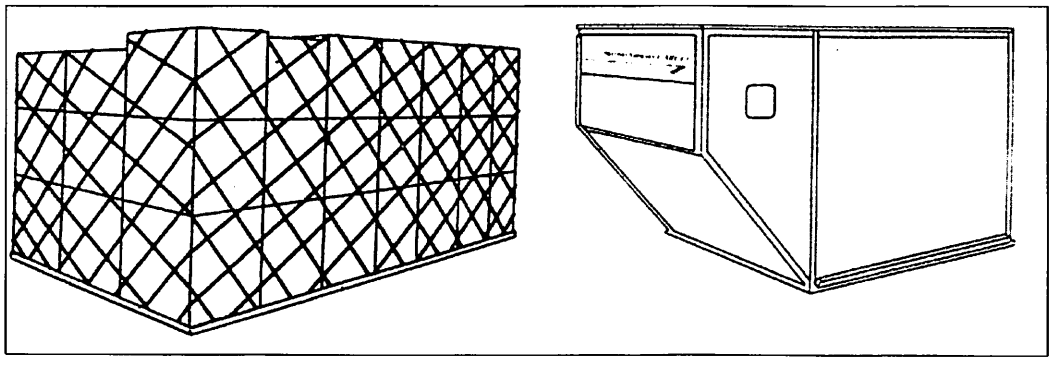

Fig. 1 Examples of open and enclosed pallets.

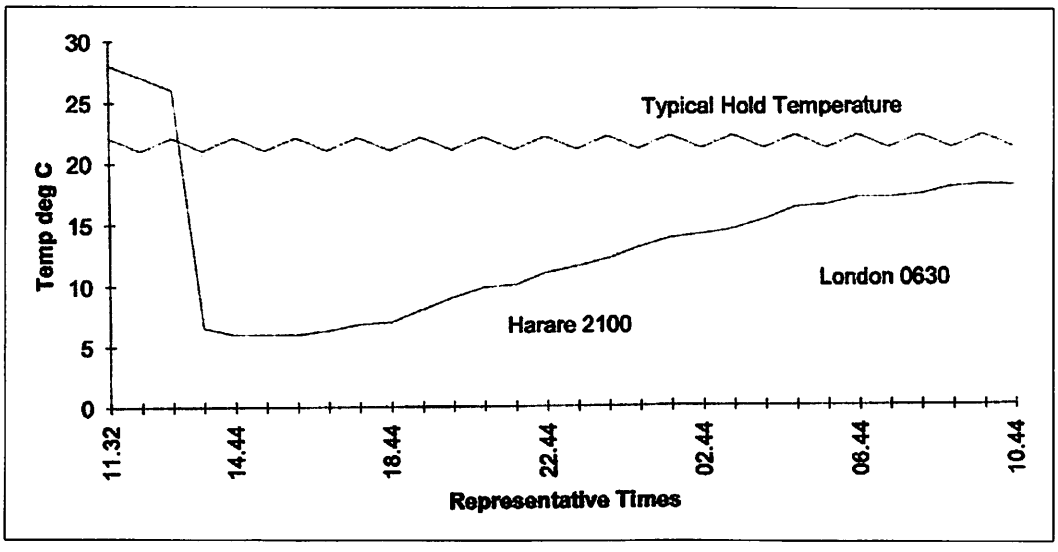

Fig. 2 Typical temperature profile for cut flowers on a passenger flight (mean of 20 flights).

packhouse in the exporting country and removed on arrival in the UK. This work has been done with the co-operation or knowledge of the air freight agents.

The temperature logger gives a record of temperature and time so the story of the situation at each stage can be known. In all cases, it is the air temperature in the box or package rather than the flesh temperature that has been monitored. Every effort was taken to put the recorders in the same location in every pallet monitored which was the second box from the outside on the second layer from the top, but this was not always achieved. However all pallets monitored had produce from only one source and were of only one variety.

All recording discussed in this paper was carried out on open pallets, that is where the boxed product is place on a plywood sheet and then netted as in *Figure 1*.

In a limited number of cases, specific cartons of product were weighed as they left the farm and as soon as consignment had cleared customs and health checks in the UK. The weighing equipment in the exporting country and the UK was checked using the same weights.

3. Results

The temperature and weight changes during transit to the UK depend on a number of factors; the temperature on arrival at the airport, cooling and holding facilities, handling systems, type of pallet, temperature on the plane and any transfers.

The summary of results of 20 flights of flower are given in *Figure 2* (Bishop, 1998). This summary shows high harvest temperatures, cooling only to 5-6°C before transit rather than the target 2°C and then a gradual increase of temperature during air transport.

In *Figure 3*, there is an example of temperatures of asparagus during transit (Bishop & Hale 1995). In this case a weight reduction of 5% was recorded

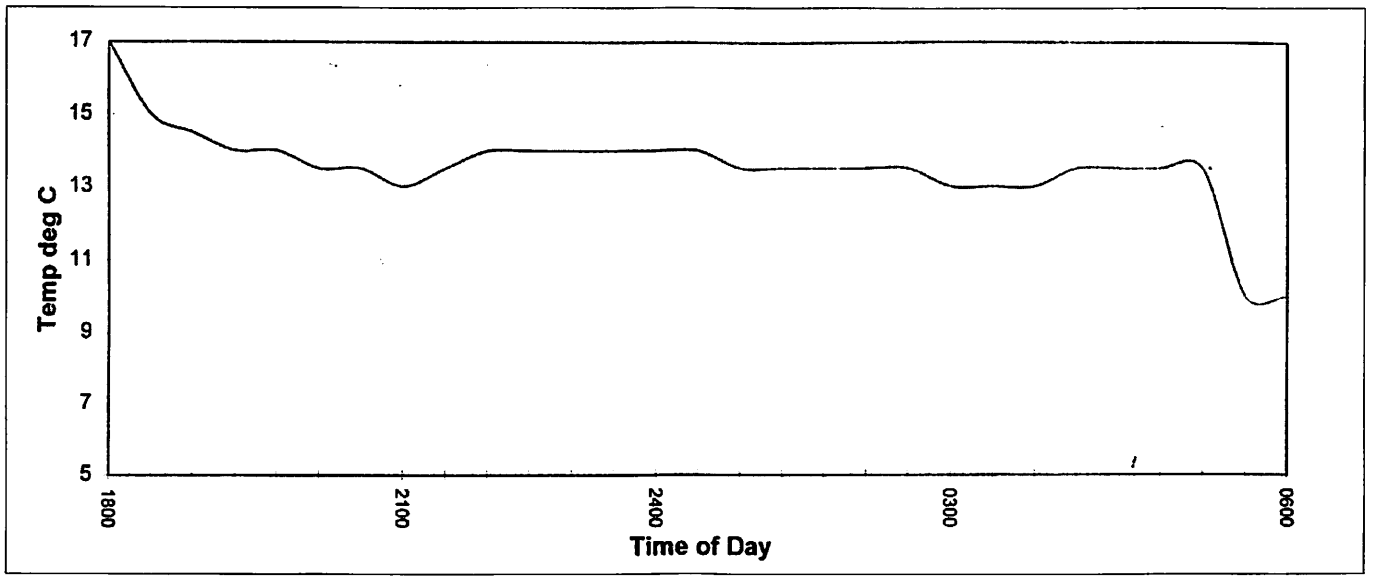

Fig. 3 Airfreight of asparagus from Zimbabwe to London.

between leaving the farm and arriving in the UK. Air freight charges are levied on the actual weight on receipt at the airport. In many cases, either in transfer as shown in *Figure 4* or at the initial loading, there is a temperature rise which negates any earlier cooling. From work done by the author in various African countries, an increase of 8-10°C during loading when the consignment is left in the sun is by no means uncommon. Spot measurements of the air temperature within boxes of 40°C and higher have been recorded on a number of occasions. Although the temperature profile in *Figure 4* is at Amsterdam, the same difficulty occurs at many other airports.

4. Discussion and future possibilities

The results highlight a number of trends. The first issue is the high temperature at which the product is arriving at the air-port. It is fully appreciated that many growers and suppliers cool their product at source but there is still much to be done in this area. Less than 10% of all flights monitored had a temperature recording of less than 4°C at any stage. It is somewhat depressing to compare the results of this study with results of 20 years ago (Harvey & Harris, 1976) and see no discernible improvement.

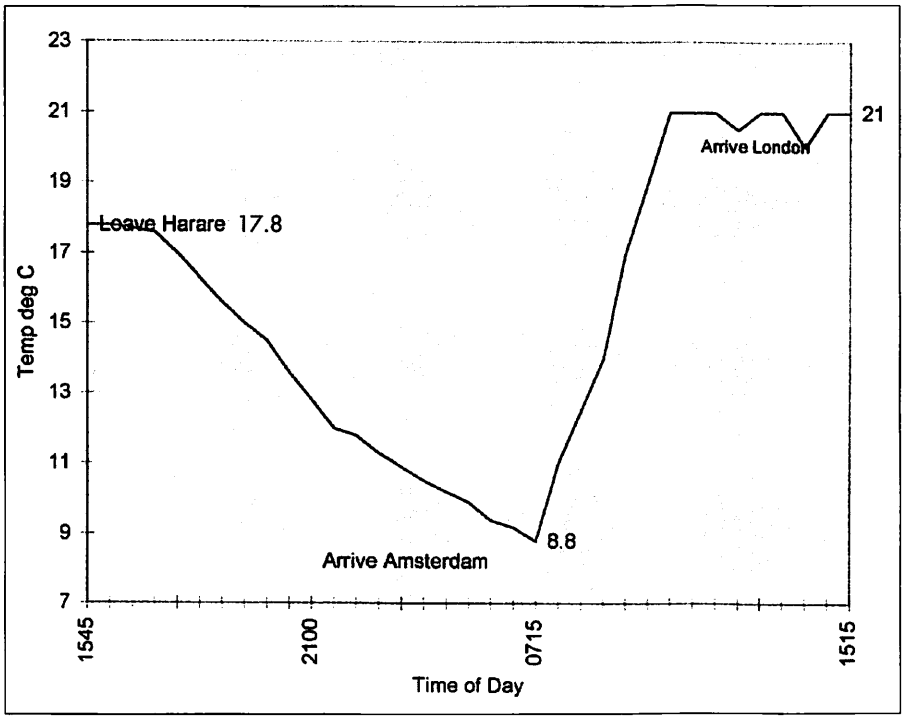

Fig. 4 Temperature changes during transfer.

Secondly, the lack of cooling facilities at the airport or their poor use is a very common situation. There is a belief that if product is placed in a store with a refrigeration system producing cold air at 2°C that the product will almost immediately achieve that temperature. The reality is that even with forced ventilation of $0.6m^3m^{-1}s^{-1}$, one hundred minutes should be allowed for seven eighths cooling of a crop like carnations (Wang & Rudolphij, 1994).

4.1 Temperature time indicators

Although some companies are secretive about their temperature monitoring, there would appear to be a lack of actual data of the full process as opposed to an impression formed by spot readings. There are many reasons for this including the cost of temperature recording equipment and the time required to produce the information if a computer is required or sometimes the difficulty in reading a thermal trace. Temperature time indicators (TTIs) could provide some of the information required in specific and possibly limited situations.

Most temperature time indicators are based on two chemicals which on reaction produce a different colour. The size or intensity of the colour is dependent on temperature and time. The indicator is normally in the shape of a label which can be stuck to side of a box and is acti-

vated by applying pressure which then breaks a paper membrane between the two chemicals. By choosing the correct chemicals, the colour change can be activated at different temperatures. Work at Writtle College has been with an indicator that changes temperature at 17°C and has been found to be repeatable and for the colour change to begin in the region of 15-18°C. It is important that the label is activated after the cooling process and checked as the produce is collected from the receiving airport. The choice of 17°C was so that the importer could know that there had been no high temperatures during transit. This choice of temperature would depend on the requirement.

4.2 Insulated containers

If lightly processed produce is air freighted, the lack of cooling on the aircraft is a factor of even greater concern than with just fresh produce because of the microbiological risks . The cost, additional weight and lack of flexibility precludes the use of refrigerated containers on an aircraft. There has been some work using insulated aircraft containers but even then there is a lack of carrying capacity which is a disadvantage if the container is not carrying perishables. One approach is to have an insulated 'coat' which can be hung on four screws inside the container and then taken out at the end of the trip, folded up and sent back for another consignment. This system has been combined with filling the container 85% full and then adding dry ice above a polystyrene barrier. Because of the insulation, a more accurate estimation can be made of the quantity of dry ice required to maintain the correct temperature. Full monitoring of this system has not been possible by the author but spot readings within an hour of the aircraft landing have produced figures always in the desired range of 4-8°C. These spot readings agree with the experiments of Bollen *et al.* (1995) on asparagus.

4.3 Refrigerated containers

There are a few refrigerated aircraft containers using dry ice and a battery powered fan. There has been no opportunity to monitor these containers. It is not thought that, in there existing form, they will become more common as the transport volume is reduced by 20-30% and there is the additional weight of the fans, *etc.*, which makes the containers unattractive for other uses. There is, however, a great deal of interest in some form of refrigerated container or pallet, particularly for freshly prepared produce with very critical temperature requirements.

Acknowledgements

The assistance of various former students at Writtle College as well as funding from the Douglas Bomford Trust is gratefully acknowledged.

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Case tractor assembly plant proves its excellence

The success of Case UK Ltd in launching a totally new tractor within two years instead of the usual six year timescale has earned the company's Doncaster Tractor Assembly Plant the 1998 Michelin Excellence Award.

Eight companies competed in the finals, held as part of the 16th teamwork conference promoted by the National Society for Quality through Teamwork (NSQT), now recognised as the leading teamwork event in Europe, at the University of Warwick.

Tractor Assembly Manager John Wildsmith who, with three colleagues, represented the launch team for the new CX Series of tractors, said afterwards: 'What emerged clearly from the project was that if you give people responsibility and resources, they will respond with commitment and more.'

Plant Manager Roger Purdy, added: 'The team gave a fantastic performance at Warwick which reflected the effort, enthusiasm and commitment put in by everyone at the Doncaster Plant. It makes me feel extremely proud to share in the success of the CX project.'

The tight schedules necessary for the CX development called for total dedication. Fifty CX tractors were built during this period to iron out all assembly bugs before full production commenced and a sophisticated problem reporting system was devised to include even the smallest detail. Another vital stage was the intensive operator training given so that everyone was fully prepared for production start-up which, on the day, proved to be trouble-free.

At the finals, the CX quartet made a 20 minute presentation on stage in front of an audience of 200 followed by 10 minutes of questioning by a panel of judges. Several months previously, 54 organisations from a wide range of industrial activities had made written submissions for initial assessment to determine the finalists.

Additionally, the NSQT conference was the stage for the finals of the 1997 Perkins European Quality Award, also won by Case United Kingdom for the implementation of the company's Total Quality Management Systems.

Book Reviews

Site Engineering for Landscape Architects, 3rd ed

by Steven Strom and Kurt Natham

Publisher: John Wiley & Sons
ISBN 0471-29196-X
Price: £47.95 (hardback)

'A user friendly guide to site engineering terms, concepts and procedures.' The shaping of the earth's surface is one of the primary functions of site planners and landscape architects. This shaping must not only display a sound understanding of design principles but also ecological sensitivity and technical competency.

This book provides practising planners and architects with reference to current site engineering trends, practices and regulations. Based on both authors' classroom and field experience, the material, examples and problems have been organised to provide the reader with a progressive understanding of the subject from landform and contour lines followed by an explanation of interpolations through to environmental and functional constraints and design opportunities. In addition, earthworks terminology, construction sequencing and the computation of earthwork volumes are presented. It also includes storm water management and the design and sizing of management systems. There are also 2 chapters devoted to the basic engineering necessary to lay out roads and drives in the landscape. Altogether there are 300 pages packed with very useful facts and information.

The easy to follow text is supported by many good quality photographs, informative drawings and diagrams. A comprehensive glossary, bibliographical references and, finally, an index complete this work.

Inclusion of real-world worked examples and skill building exercises will reduce the learning curve and make it easier for students to quickly master the terminology, principles and practices involved in environmentally sound engineering. A great many exercises are included but one small problem occurs in that there are no answers given for students to check their work.

The other problem with this book relates to units. Use of both SI and Imperial Units might be confusing and in future should be rectified. But despite the above, it is a good teaching text and also an appropriate reference guide for practitioners.

Although intended for architects this book will be very useful for site work in soil and water engineering. At £50 it is reference book for the library rather than a recommended text for every student.

GL & MJH

Farm Building Cost Guide

The Scottish Agricultural College Building Design Unit
ISBN: 1-85482-503-8
Price: £19.80

I have now lost count of the number of times I have reviewed editions of this excellent guide. Suffice it to say that it was first published in 1976, it was very good then and 24 editions later it maintains and even improves in quality.

For those who are not aware of this guide, may I inform you that it is the most (perhaps the only) comprehensive up to date source of rural building cost information available.

It is invaluable to practising engineers pricing projects from complete buildings through to individual equipment and a wide range of materials. I have often used it for costing earthworks and found it to be pleasingly accurate. It is also extremely easy to use; there is, in fact, a section at the beginning of the book explaining how the work can be approached. The joy is though that it can be approached in a whole range of ways in tailoring to the particular users need.

So, it simply remains for me to congratulate the team on producing another edition of such high quality; further, to thank them personally for providing me with an excellent aid in my work; and finally to recommend it to all who have need to cost anything from digging a hole through to pricing a dairy unit. Buy it tomorrow you will find it invaluable.

MJH

Video review

County Tractors

by Stuart Gibbard

A Video from Farming Press (Miller Freeman Plc)
ISBN 0-85236-382-6

As is evident from earlier reviews of 'Classic Machinery Videos' I am not a fan. They are usually a series of production types run together with no particular aim other than to provide the viewer with a memory file.

I am pleased to be able to say that in this case no such criticism is valid. It is a first class compilation panning the history of County Commercial Cars Ltd (1929 to 1983).

So how does this one vary so much from the general run. One reason is the wide ranging history of the company (lorries, tanks, forestry machinery, construction plant, crawlers and four wheel drive to name but a few).

Secondly, from the quality of the footage, someone at County must have been a keen film maker. There is therefore high quality material and lots of it. The outcome is a well-compiled theme using the very best archive material. Some of the film is in fact remarkable. The famous 'sea horse' crossing of the English Channel, early test track work of one man tanks, and working paddy fields in the Philippines are all included, so my recommendation is that if you have an interest in good quality historic documentation of 'off road' engineering, then make sure this video is in your collection.

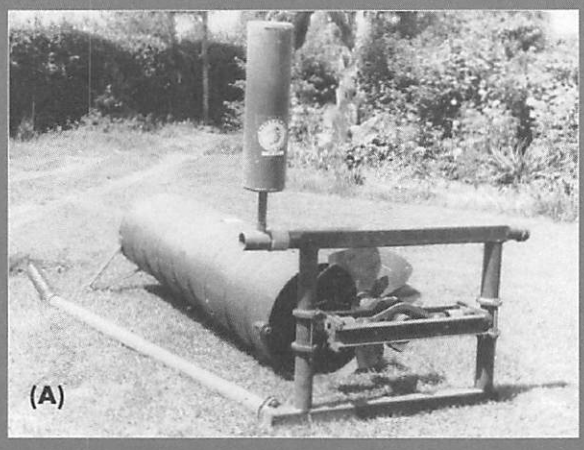
MJH

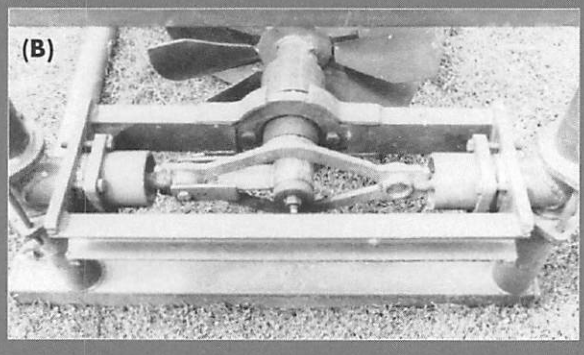
Letter to the Editor

Dear Sir, 23 October 1998

I was interested to read the comments on the hydram in the section dealing with 'Company and Product Information' in the Autumn issue of the IAgrE Journal and enclose two photographs and description of a somewhat more modern device for water raising which is made in Kenya and may interest your members. I happen to have been using one for 14 years as the sole source of water in a dry area that testifies to its durability.

It is called the 'NDUME Turbo-pump' and, unlike the classic hydram, requires a fall of only 0.5 - 1.5 m but performs better at the higher level. This amount of fall can often be found naturally in streams and small rivers or can be created fairly easily and cheaply.





NDUME Turbo-pump (a) the intake pipe and filter are on the left and the water outlet is below the air bottle; and (b) the connecting rod between the pistons and cylinders, and the turbine blades.

The water flows down three 200 litre drums welded to form a pipe and then drives the axial flow fan which is connected directly to two opposing pistons and cylinders with pressure differentially actuated inlet and outlet valves held by light springs. The inlet pipe is level with the water intake and thus feeds the pistons at a slight pressure, so avoiding priming difficulties.

The positive displacement pump can produce a head of 125 m but the maximum recommended is 90 m as much depends on the strength of the components fitted after the pump. Optimum speed appears to be 90 - 180 rev/min as above these speeds the output seems to remain constant, probably due to the limitations of the valve arrangements.

The stroke of the pistons can be adjusted to suit both the water flow and pumping head; so, it can be reduced during the dry season when the flow decreases but the need is the greatest. My machine gives about 3000 litre/h at a head of 45 m up a 2.7 km pipeline but does this for 24 h per day.

To make maintenance simple, the bearings and seals are standard truck components and greasing is vital as is the daily cleaning of the intake of leaves and sticks. The rate of wear of the washers and cylinders depends on the silt load in the river but mine do 2-3 years between changes. Maintenance is simple as only two sizes of nut are used as with the TE-20!

Further details are available in: 'The NDMUME Turbo-pump - a user experience', T B Muckle, *Waterlines*, **10**(4), April 1992.

The manufacturer is: NDUME Ltd, PO Box 62, Gilgil, KENYA. Tel: +254 367 5250/1/2. Fax:+254 367 5254.

Yours faithfully

T B Muckle MIAgrE

Tripie W Engineering Ltd
PO Box 176
Naro Moru via Nyeri
KENYA

Two professional engineering institutions discuss merger

Merger talks have commenced between two major organisations which together represent the professional interests of Incorporated Engineers and Engineering Technicians across the full spectrum of engineering - The Institution of Incorporated Engineers (IIE) and The Institution of Incorporated Executive Engineers (IIExE).

A joint working group has been established to advise the Councils of both Institutions on the way forward and to develop firm proposals for presentation to their memberships.

Earlier this year, IIE was formed by the amalgamation of the three former organisations - The Institution of Electronics and Electrical Incorporated Engineers, The Institution of Mechanical Incorporated Engineers and The Institute of Engineers and Technicians. It has attracted widespread attention as an important new force in the engineering profession, representing the roles and values of the Incorporated Engineer and the Engineering Technician.

IIE is now the fourth largest of all the professional engineering institutions. A merger would generate a membership of well over 40,000 which would further strengthen the voice of Incorporated Engineers and Engineering Technicians.

The Cardiff Bay Barrage is in place and working

Scientists at Cardiff University have created a unique working model of the Cardiff Bay Barrage which is helping to predict how the barrage will effect urban drainage within the city.

This important experiment will identify water quality within the Bay, and is taking place within the University's newest laboratory, which is sponsored by Hyder plc, Wales' largest public company. The **Hyder Hydraulics Laboratory** consists of a large tidal basin for studying flow, water quality and sediment transport processes in coastal and estuarine waters. Leading the research undertaken within the Laboratory and in the Environmental Water Management Research Centre are Professor Roger and Dr Binliang Lin who are acknowledged as among the world's experts on designing computer modes to predict the likely effects that urbanisation and industry has on the quality of water in rivers, estuaries and reservoirs.

The tidal basin can simulate model tides of varying height and frequency and can also simulate longshore currents in either the tidal direction or against the tide. The basin will be used to study under controlled conditions many of the complex flow and water quality processes occurring in coastal and estuarine basins. By improving our understanding of these processes, computer models will be improved to predict these processes more accurately at the prototype scale and with real life tidal, wind and river flow conditions.

In the first instance, the 1:1000 physical model of Cardiff Bay will be located in the basin, with the aim being to take detailed measurements of the flow and diffusion process relating to rivers and stormwater overflows discharging into large embayments. This project is being funded by the Natural Environment Research Council, with the improvements to these coastal processes being included in the 2-D and 3-D computer models DIVAST (Depth Integrated Velocities And Solute Transport) and TRIVAST. These computer models are used extensively for Environmental Impact Assessment studies and have been acquired by more than 35 companies from the Cardiff Research Centre for application to over 80 assessment projects worldwide.

In another newly built flume, detailed experiments will shortly commence to study the flow and nutrient processes in mangrove swamps and establish how these processes may change as a result of deforestation. This project is being funded by the Department for International Development and has particular relevance to many developing countries, such as India, where depletion of mangrove forests has had a considerable impact on aquaculture and the coastal ecosystem. Again, the results of this research will be included in computer models, which will provide more accurate predictions of the sustainable balance between development and coastal environmental protection in some of the world's poorest regions.

'The human race is producing vast amounts of waste and is causing unnatural changes to our habitat,' said Professor Roger Falconer. 'As a result, a great deal of waste and sediment material will eventually drain into our rivers and seas. Our concern within the Hyder Hydraulics Laboratory is to manage this output and to prevent widespread and long-term damage pollution.'

Mike Brooker, Managing Director of Hyder's water business, Dwr Cymru Welsh Water said: 'This new laboratory will house many exciting experiments, starting with the Cardiff Bay barrage project. Hyder has an international track record in water and environmental projects and we are delighted to extend our support to this initiative.'

The Hyder Hydraulics Laboratory, within the University's School of Engineering, was officially opened by the Lord Mayor of the City and County of Cardiff, Councillor Marion Drake, on 7 October.

Top honours for 'green' engineers

A unique process that substantially reduces harmful emissions from a plastics and resins materials plant has earned a team of four engineers the UK's foremost environmental honour - the Engineering Council's 1998 Environment Award for Engineers, beating more than 100 other contenders.

Engineers Ahmed Khan, Mike Oliver, Stephen Taylor and Adrian Murphy, from BIP Limited, Oldbury, West Midlands received the £5,000 prize and the Lloyd's Register Trophy from Sir Robert May, the Government's Chief Scientist and Head of the Office of Science and Technology.

The team's winning process uses the most advanced developments in biotechnology, exploiting naturally occurring micro-organisms to feed on harmful, gaseous emissions that would otherwise become greenhouse gases affecting the ozone layer.

Operating through a roof-mounted bio-reactor, the process is successfully reducing levels of both formaldehyde and methanol. Other advantages of the technology are low capital and operating costs and probably the lowest net environmental impact compared with other abatement options.

Second place was awarded to Chartered Engineer Timothy Gardner, of Gardner Energy Management, Bristol, who receives £2,000 for his energy saving process that also promises to deliver major cost savings for industry. His GEM Trap involves a more effective method of cleaning impurities from the steam systems that are used in several industrial processes. The 'steam trap' invention involves no moving parts and is claimed to be more reliable, eliminating the energy-wasting faults of conventional mechanical systems.

Three engineers at aero engine manufacturer Rolls-Royce who spearheaded a project that is successfully reducing pollution from jet engines received a highly commended

continued overleaf

award of £1,000. Bryn Jones, Desmond Close CEng, and Ashley Owen have developed the 'Phase 5 conductor' - a low emission engine combustor that is not only being applied to the latest generation of Rolls-Royce big jet engines, but can also be applied to a range of engines in service. The RB211-524 engine fitted with the new conductor produces 40 per cent less N0x and works in conjunction with improved compressor and turbine component efficiencies to reduce fuel costs.

The winners of the Built Environment category, sponsored by the Chartered Institution of Building Services Engineers and receiving a prize of £3,000, were Ivan Kitchen and Tony Hill, of ENTEC UK, of Cramlington, Northumberland, and Steve Coverdale CEng, of Northumbrian Water Limited.

They were responsible for a project treating sludges produced as a result of waste water purification. This produces a useful, re-usable product, which reduces landfill waste and minimises road traffic because ship transport is used. The project also involves the opportunity to generate gas from the dried sludge.

The Best Practice in Environmental Management award of £3,000 was presented to Stephen Mountain CEng, Head of Technical Services at Havant Borough Council, Hampshire, in recognition of his civil engineering project reclaiming the local Oyster Beds area to its rightful role as a nature conservation area from being the dumping ground for 100,000 tonnes of rubble.

The Environment Award for Engineers brings recognition to the positive contribution engineers and technicians make towards protecting the environment through their work in providing an engineering problem towards protecting the environment.

The award is sponsored by Lloyd's Register, Foster Wheeler Energy, the Chartered Institution of Building Service Engineers (CIBSE) and UKAPE (United Kingdom Association of Professional Engineers).

HSE information sheet tackles deaths from confined spaces on farms

The Health and Safety Executive (HSE) has published a new agricultural information sheet - *Managing Confined Spaces on Farms*, which gives advice on the risks from areas such as moist grain silos, slurry pits or silage clamps, to help farmers meet with the requirements of the Confined Spaces Regulations 1997.

Entry into confined spaces, like moist grain or forage silos and slurry stores is hazardous because the air inside may be unbreathable. People have died whilst making repairs, retrieving something, or clearing a blockage, without appreciating the risk. Some incidents have claimed more than one life when rescuers were ill prepared or when proper rescue arrangements were not in place.

Commenting on the situation, David Mattey, HM Chief Agricultural Inspector, said: 'All of the deaths could have been avoided by those in charge of the task - in some cases the very people who were killed. Now that farmers are beginning to think of the need to open up forage towers or moist grain silos, and prepare slurry stores for the winter months, they and their staff may need to enter confined spaces. Planning is the key: straightforward steps can be taken - and now must be taken under the Confined Spaces Regulations 1997- to reduce the risks, not only in farming, but in any workplace where they apply.'

The information sheet explains how the Regulations apply to agriculture and gives straightforward advice on minimising the risk from working in confined spaces. It is aimed mainly at protecting agricultural workers, but it also raises the need to consider others who could gain access to confined spaces on farms.

It explains 'confined spaces' and the steps to managing them safely that will be familiar to anyone already following the risk assessment and control process. Following these steps is likely to result in farmers meeting their main legal obligations under the new Regulations.

The rules for safe working are to:

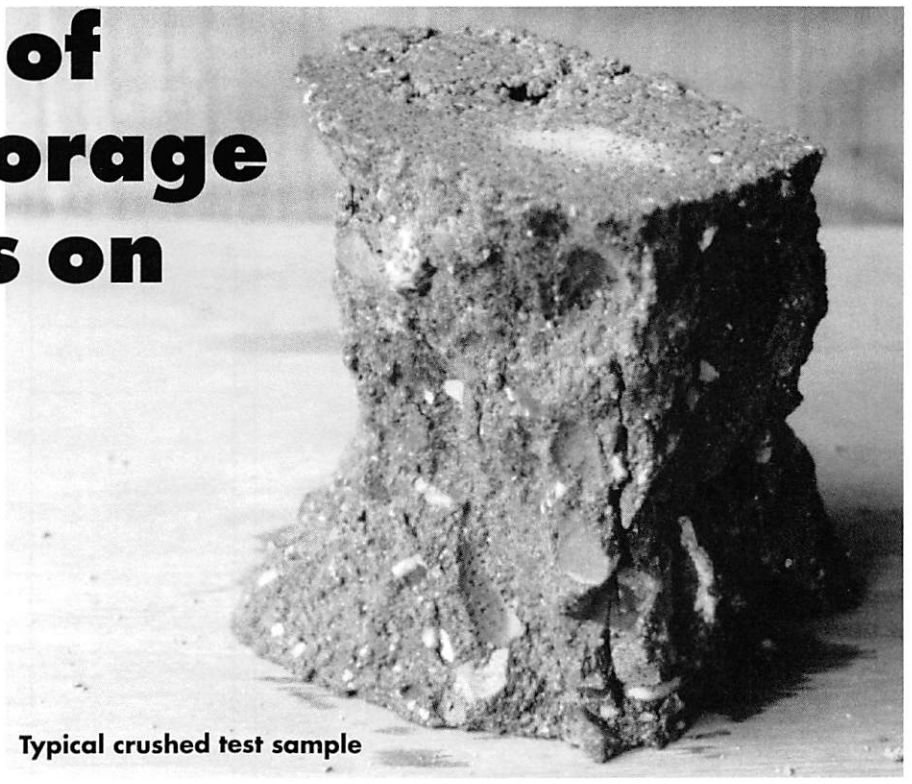
- avoid working in a confined space whenever possible, for example by doing the work from outside;
- follow a safe system of work if it is necessary to work inside; and
- make appropriate arrangements for rescue in an emergency.

The guidance illustrates these rules through the familiar examples of sealed moist grain tower silos, indoor silage clamps, slurry storage systems and forage tower silos.

Mr Mattey added: 'The problem is that confined spaces are often not obviously dangerous. You can't see a lack of oxygen! Farmers who are already properly managing access to confined spaces probably have little more to do. But everyone should review their own situations, and measure them against the safe working rules. The law places an obligation on those responsible for safety to identify hazards, assess the risk, and manage that risk. This information sheet gives guidance on what should be considered in meeting that legal obligation in confined spaces.'

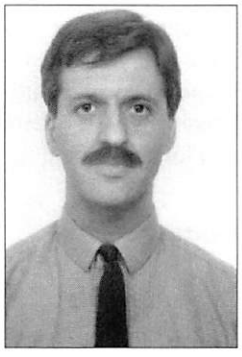
Copies of HSE Information Sheet No 26 'Managing confined spaces on farms' are available free from HSE Books, PO Box 1999, Sudbury, Suffolk, CO10 6FS. tel: 01787 881165.

Influence of cement storage conditions on ultimate concrete strength



Typical crushed test sample

Richard W Langley



Introduction

In excess of 12.2 million tonnes of cement are produced annually in the UK, and approximately 25% of this is sold in 25 and 50 kg bags. Many farmers, builders and DIY enthusiasts have reason to use small quantities of bagged cement, and are often faced with the dilemma of whether to use left-over or stored cement from an open bag which may not be in the same condition as new. Does it make any difference to the strength of the cured concrete if the cement used has been opened for some while? It seems that very little, if any, research has been done relating to degradation of cement in open bags and its effect on concrete strength, but experiments done recently at Writtle College aim to find some answers.

Compiled by Richard W Langley MIAgrE, Senior Lecturer in Agricultural Engineering, Writtle College, Chelmsford, Essex CM1 3RR, and based on the BSc Agricultural Engineering final year student project written by Richard Hardwick, June 1998.

Cement handling and storage

Cement is anhydrous and thus needs to be protected from moisture whilst being handled and stored. Most manufacturers and builders store cement in designated cement sheds which give protection from the elements, hence avoiding moisture contamination. However, as soon as cement is delivered to the site, extreme care in storage is required, and BS 8000 (BSI, 1990) recommends the following.

- Store cement in a dry, weatherproof, frost-free, enclosed shed or building with a dry floor. If the floor is concrete, store cement on a timber platform.
- Stack bags closely together away from walls and not more than 8 bags high.
- Stack bags so that consignments can be used in order of delivery.
- Check cement for deterioration when taken out of storage. Do not use if lumpy, without obtaining instructions.

According to BS 8000, even in good conditions cement stored in bags can lose significant strength (*e.g.* 20%) after about 4-6 weeks. This relates to new unopened bags, but information on the storage of opened bags is not readily available either from cement manufacturers, the British Cement Association (BCA) or British Standards. Cement bags are printed with a code which gives the manufacturer's information on filling date and plant at which the cement was produced, but they are not printed with valuable data for the end user such as expected shelf life or storage requirements and life *after* opening. The only indication that moisture may be a problem is a printed symbol often seen on bags 'Moisture Resistant Bag - Keeps Fresher'. Storage advice from the BCA is to empty the contents of the opened bag into a plastic bag inside a sealable plastic bucket.

Definition of cement

In the general sense of the word, cement can be described as a material capable of bonding mixed fragments into a compact whole (Neville, 1995). The constituent parts are both cohesive and adhesive. In the construction industry, the term is restricted to one of bonding the materials employed, *i.e.* sand, stone, bricks, blocks, *etc.* The principal components which make up cement as used in the construction industry are compounds of lime, and are therefore known as 'calcareous cements'.

Cements used for making concrete have the distinct property of setting and hardening in water, *i.e.* they depend upon water for strength and are known as 'hydraulic'. Portland cement, the most commonly used hydraulic cement in the construction industry, consists mainly of silicates and aluminates of lime; the approximate percentage of lime is 60 - 67%, silica 17 - 25%, and alumina 3 - 8%. Essen-

tially, the manufacture of cement consists of grinding the raw materials, mixing them intimately in predetermined proportions and burning them in a kiln at temperatures of around 1450°C. The burning process causes partial fusion into balls known as clinker, and this resulting clinker is cooled and ground into fine powder with the addition of approximately 5% gypsum to regulate set; the resulting fine powder is called Portland cement, and has of the order of 1.1×10^{12} particles per kilogram (Neville, 1995).

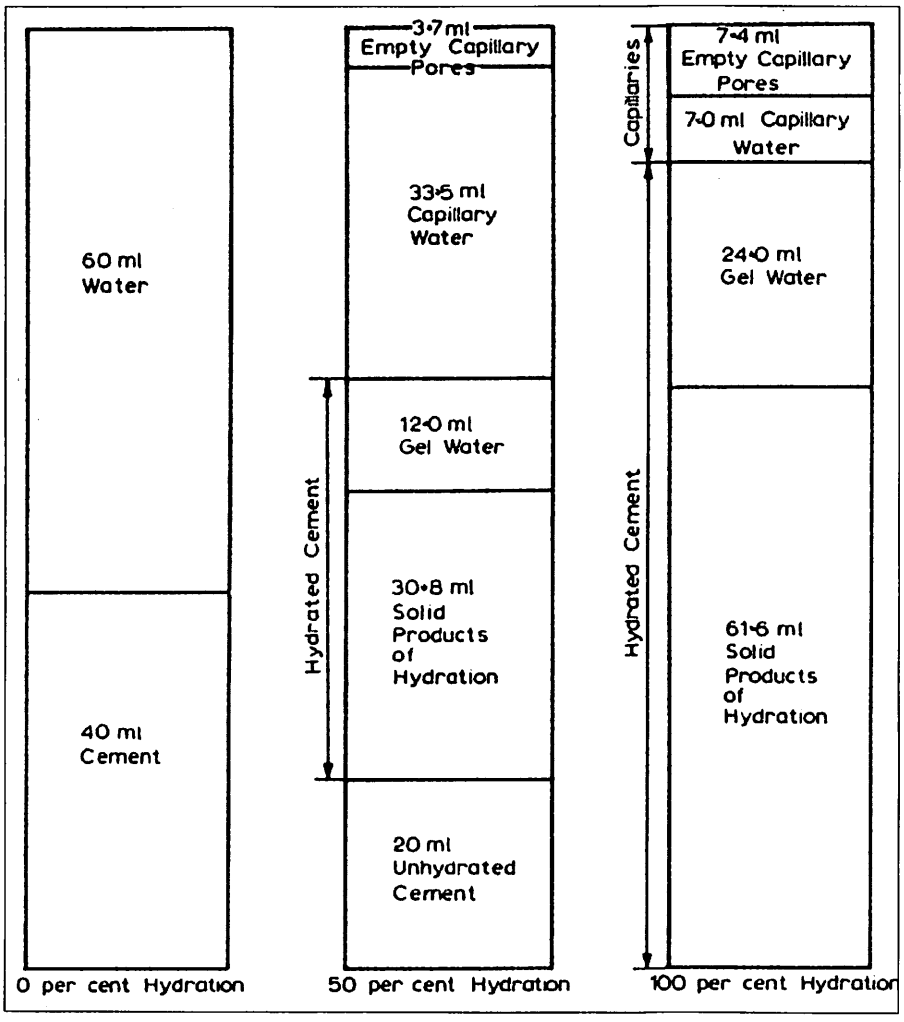


Fig. 1 Diagrammatic representation of the volumetric proportions of cement paste at different stages of hydration.

Hydration

Hydration is the irreversible reaction by virtue of which cement becomes a bonding agent; *i.e.*, when cement is mixed with appropriate quantities of water and suitable aggregate, it forms a coherent mass and becomes hard and mechanically resistant. It is a process that is extremely complex to explain in chemical terms, but the end result of hydration is quite obvious to anyone. The components of cement are anhydrous (without water) and when brought into contact with water, are all attacked or decomposed, forming hydrated compounds (Lea and Desch, 1956). The water contacts the cement grains over the whole of their surface, and it seems that hydration proceeds by gradual reduction of the cement grain. It appears that the compounds react in equal proportions within the cement grain, such that microscopic analysis of hydrated cement shows no evidence of water channelling into grains to selectively hydrate more reactive compounds (Neville, 1995). The progress of hydration can be determined by several means, such as the amount of $Ca(OH)_2$ in the cement paste, or by the heat evolved by the process.

The progression of hydration from a water-cement mix to a fully formed structure is illustrated in *Figure 1* (Neville, 1995). It can be seen that the 'gel' fills the spaces as hydration occurs, reducing the volume of capillary pores. The importance of eliminating continuous capillaries is such that this might be regarded as a necessary condition for a concrete to be classified as 'good' (Neville, 1995). Hydrated cement bonds firmly to unreacted cement, creating larger particles; there are various theories as to how this happens, but these will not be discussed here.

Cement fineness

The importance of the fineness of grinding to the value of cementing material is twofold. Firstly, a fine powder is able to coat the surface of the aggregates more completely than a coarse one, ensuring a more intimate contact of the components of the mortar. Secondly, the reaction between cement and water takes place only at the surface of the solid particles – hence, the more finely ground a cement, the greater is the surface exposed in proportion to its mass, and the more rapid and complete the hydration (Lea and Desch, 1956). Early editions of BS 12 (BSI, 1996) recommended a specific surface for Portland cement to be not less than 225 m^3/kg, but the European Standard BS EN 196 does not specify a minimum fineness. (Interestingly, the term Portland cement is no longer used in the latest standards).

Moisture movement into cement

Cement is an anhydrous material and, as such, the air contained in it has little or no moisture content, *i.e.* a relative humidity (RH) of 0%. Ambient air, however, has a considerably higher moisture content, for example, 55% or higher. Thus, there is an imbalance in RH between the air in the cement and the ambient air; in other words, there is a 'RH differential' (Hobbs, 1998). This imbalance leads to moisture from the ambient air moving to the air within the cement in order that equilibrium be achieved. However, the moisture moving into the cement is taken up and bonded to cement grains by hydration, which again leaves an imbalance of RH; this in turn attracts more moisture into the cement seeking equilibrium. This will then explain how bagged cement appears to 'go off' from the outside inwards.

Concrete

Concrete is a homogeneous mass made up from a mixture of water, cement and aggregate, and it needs to fulfil two main criteria before it can be classed as 'good' concrete. Firstly, the concrete has to be satisfactory in its hardened state, possess

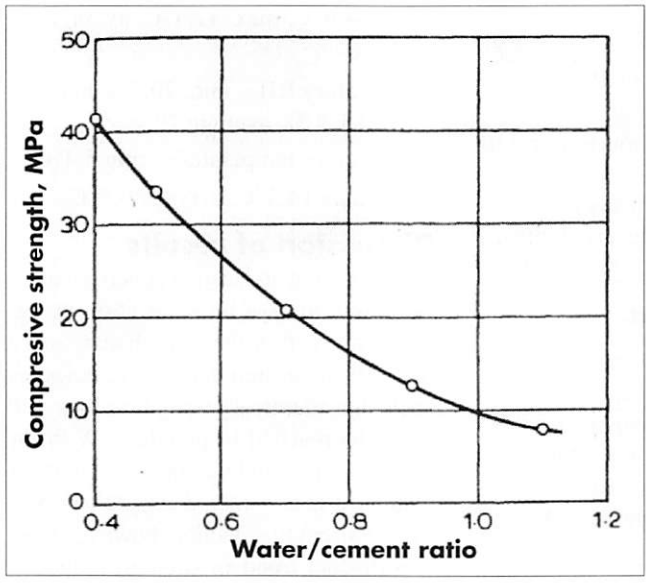


Fig. 2 Relationship between strength and water/cement ratio in Portland cement (Neville, 1995).

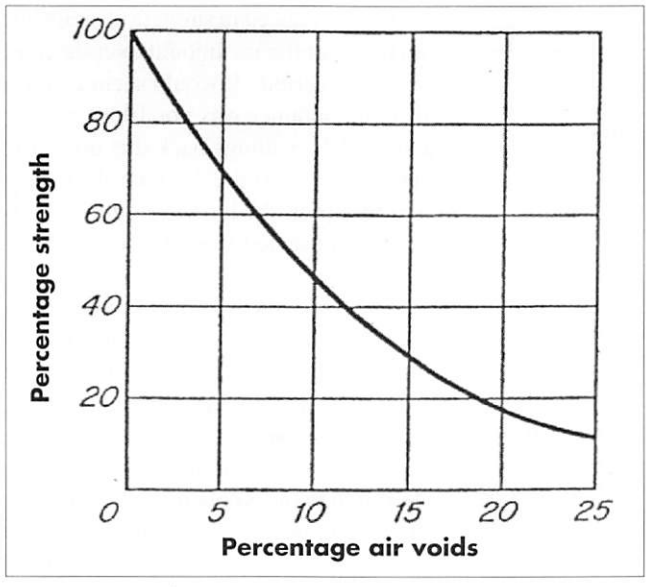


Fig. 3 Loss of strength due to air voids (Everett, 1970).

satisfactory compressive strength and adequate durability. Secondly, the concrete has to be satisfactory in its fresh state, such that the consistency of the mix can be compacted by the desired means without excessive effort; also, that the mix has to be cohesive enough for transporting and placing so as not to produce segregation with a consequent lack of homogeneity of the finished product (Neville, 1995). Of the two criteria, strength is generally considered the most valuable property of mature concrete. In the UK, strength is determined by testing concrete cubes under compression.

There are two variables which significantly contribute towards the strength of mature concrete: cement/water ratio and compaction.

1) Cement/water ratio. This may be expressed as the mass of water to the mass of cement. In simple terms, when the quantity of water in a mix increases in relation to the quantity of cement, the strength of concrete decreases as shown in *Figure 2* (Taylor, 1994). Below a ratio of 0.4, a large part of the cement never hydrates due to inadequate space and/or water quantity. Above a ratio of 0.4, the expansion of hydrated cement is insufficient in volume to fill the space previously filled with water. The resulting concrete will be porous, *i.e.* containing voids. *Figure 3* shows that for every 1% of voids, the strength is reduced by around 5%, a most important practical point.

2) Compaction. This must be carried out solely to reduce air spaces or voids, both in the concrete itself, and at the interface with formwork/shuttering. As outlined above, this has a significant effect on mature concrete.

Good concrete is therefore obtained by using a workable aggregate with the lowest water:cement ratio which enables the mix to be thoroughly compacted by mechanical means (Everett, 1970).

Concrete strength testing

Compressive strength can be determined by manufacturing test cubes (either 100 or 150 mm cubed), which are tested compressively to destruction at a predetermined age. To ensure uniformity of test procedures and interpretation of results, it is normal practice to follow BS 1881 (BSI, 1983); this covers all aspects of manufacture, curing and testing of concrete cubes. For this research, the appropriate steps according to BS 1881 were followed, but for a full description of those procedures, see the references.

Experimentation

The mix chosen for the tests was based on ST4, which is mid-range, general purpose, concrete mix having proportions of 6.2 parts aggregate to 1 part cement (by weight). All-in ballast, comprising 20 mm particles down to fine sand, was used and was stored in a one tonne bag to avoid segregation. The free water/cement ratio used was 0.35, with all ingredients carefully weighed for consistency. Water used was clean tap water, drawn from the same place each time. The experiment was carried out over a nine week period, with concrete batches made and tested at three week intervals. On day 1, three bags of Portland cement were opened, three test cubes made and tested for reference. The cement was then stored in:

- a closed bag inside an airtight bucket (reference sample), see *Figure 4a*;
- an unheated laboratory;

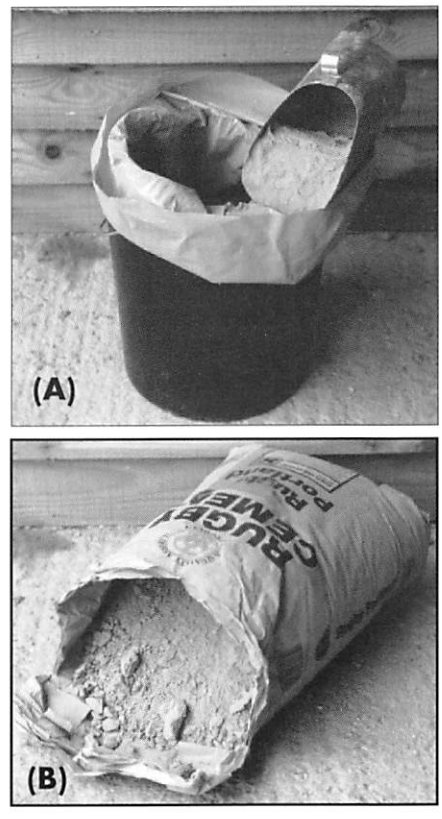


Fig. 4 (a) The 'reference' cement after storage for nine weeks in a sealed plastic bag lining a bucket kept in the laboratory; (b) cement showing considerable lumps after nine weeks in opened bags with tops folded back over and stored in a wooden shed.

Table 1 Compressive strength, reference sample.

Week no	Compressive strength, N/mm²				Comment/ observation
	Cube 1	Cube 2	Cube 3	Mean	
0	14.5	15.0	15.0	**15.0**	Fresh cement, floury, warm to touch
3	13.0	13.0	13.5	**13.0**	Cement still appears fresh
6	12.5	12.5	12.0	**12.0**	No colour change, no lumps
9	10.5	11.0	11.5	**11.0**	Still appears as fresh as day 1

Table 2 Compressive strength, cement from wooden sbed.

Week no	Compressive strength, N/mm²				Comment/ observation
	Cube 1	Cube 2	Cube 3	Mean	
0	14.5	15.0	15.0	**15.0**	As reference sample
3	7.0	6.0	7.5	**7.0**	Cement quite lumpy, but broke down adequately
6	4.5	5.0	6.0	**5.0**	Much coarser grains, still green in colour and cold to touch
9	5.5	5.5	4.0	**5.0**	Solid at bag sides, but able to break down lumps

Table 3 Compressive strength, cement from laboratory.

Week no	Compressive strength, N/mm²				Comment/ observation
	Cube 1	Cube 2	Cube 3	Mean	
0	14.5	15.0	15.0	**15.0**	As reference sample
3	12.5	6.0	7.5	**9.0**	
6	5.5	5.0	5.0	**5.0**	
9	4.0	4.5	5.5	**5.0**	

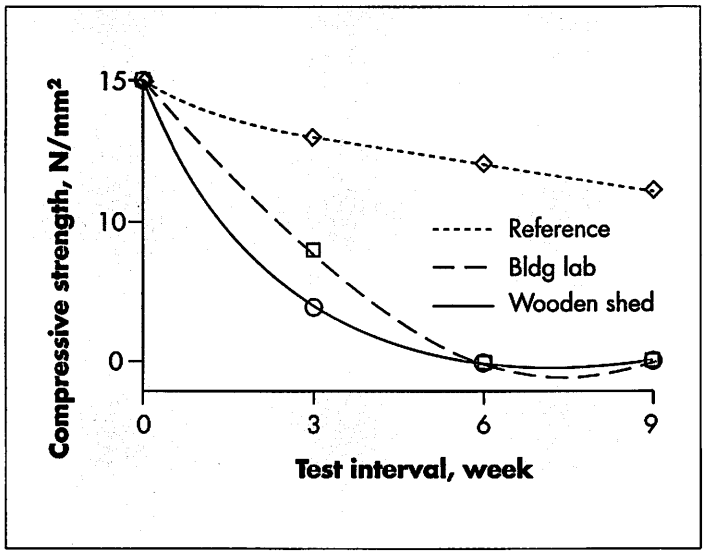


Fig. 5 Seven day compressive strength of concrete test cubes.

- an unheated, enclosed wooden shed, chosen to simulate a garage, or typical agricultural building, see *Figure 4b*.

Note that the cement was stored off the ground to allow full air circulation and to avoid ingress of moisture from the concrete floor.

At the end of each three week period, three cubes were made for each storage batch of cement; these were manufactured and tested in accordance with BS 1881, with all results, including the physical condition of cement, carefully noted (Tables 1-3).

Figure 5 shows a graphical representation of the compressive strength results. Some temperature and humidity readings were taken over a period of around three months for the three batches of stored cement, and these can be summarised as:

'reference' relative humidity (RH) – min. 46.8%, max. 63.2%, average 51.9%;

wooden shed RH - unreliable figures since they were above 100%;

wooden shed temperature – min. -4.9°C, max. 12.4°C, average 5.5°C;

laboratory RH – min. 70.5%, max. 84. 1 %, average 79.4%;

laboratory temperature - min 5.4°C, max 14.5°C, average 9.3°C.

Discussion of results

When making and testing concrete cubes, there will always be a variation in figures even within the same batch, and it has been suggested that the variables are such that identical strength values will never be reached in practice. With the size of sample and variance within these results, it is considered unsafe to quantify the strength reduction; however, there is a distinct trend in strength reduction between the reference sample and the cement subjected to air. The reference sample, which was stored in an airtight container, reduced in strength steadily but not by a significant amount over the nine week test period. It would seem that the airtight container was not 100% sealed, and the RH readings back this up, varying from 46.8 to 63.2%. To be absolutely sure of a seal, the bucket would need to be vacuum sealed from day 1 of the experiment.

The two cement samples subjected to air through opening their sacks, lost strength very rapidly, as shown in *Figure 5*. Between tests, the tops of the bags were rolled over in a simple and crude attempt to 'seal' them from air. The sample stored in the wooden shed reduced in strength more rapidly in the first three weeks, and both continued to lose strength until six weeks, when the curves levelled out.

The rapid initial reduction in strength indicates that the moist air is easily taken up by fresh cement, then moisture entrapment is reduced as the cement hardens around the outside of the mass. This argument is supported by the fact that the cement in the centre of the bag remains reasonably fresh, whilst the outside becomes hard. Samples used for the tests were taken randomly from the bags. The strength decay was surprisingly fast and, at three weeks, the outside of the opened samples had become quite hard, containing small lumps. The outer layer became thicker as time passed, with larger lumps forming but, even at nine weeks, it was still possible to break the lumps down into what appeared a reasonably fine powder. Using this cement will ultimately lead to inferior strength concrete/mortar.

The findings of the study have highlighted two possible reasons for cement degradation. Firstly, cement is anhydrous in its fresh state and, when water is added, hydration occurs. In concrete/mortar, as hydration happens, a gel is formed which fills the voids between the particles of aggregate, and the aggregate adheres together into a coherent mass. The moisture that moves into the cement when the bag is opened begins the irreversible hydration process, and the consequence is that there are less unhydrated grains left to react when the concrete/mortar is finally made. Secondly, unhydrated cement grains are attracted (and attach themselves) to the grains undergoing hydration, and the result of this is increased grain size. Fineness of cement plays a significant part in the speed and completeness of hydration.

Both of the above theories result in insufficient cement gel being formed to completely fill the voids between the aggregates in the concrete, and the result of this is air voids in the concrete left by the evaporation of water which has not been chemically combined into the hydrates. As seen earlier, air voids contribute considerably to strength loss in concrete.

Conclusions

Cement degrades rapidly once subjected to air, and the effect on concrete strength is quite considerable.

There appear to be two possible reasons for cement degradation and reduced concrete strength: increased grain size during hydration resulting in less surface area for water contact; irreversible hydration reducing the effectiveness of cement.

In a condition resulting in a considerable reduction in concrete strength, cement from an opened bag can still be broken down into what appears to be a serviceable material. There is no advisory data available to the end user outlining shelf life of opened bagged cement, or how to store opened bags properly.

It is recommended that:

- cement manufacturers and other professional associations should promote awareness of the degradation of cement, and its subsequent effect on concrete strength;
- small quantities of cement, in opened bags and retained for later use, *should* be stored in a plastic bag within a sealed plastic bucket in order to keep it as fresh as practically possible;
- further work be carried out to measure the fineness of cement at each test; and to measure the temperature within the cement, which would indicate the presence of hydration.

References

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British Standards Institute (1983). BS 1881 Parts 108, 111, 116, 125 (Manufacture and testing of concrete cubes).

British Standards Institute (1990). BS 8000 Workmanship on Building Sites, Section 2.1 Mixing and transporting concrete.

Everett A (1970). Materials. Batsford Ltd.

Hobbs D W (1998). Personal Communication. BCA.

Lea F M, Desch C H (1956). The Chemistry of Cement and Concrete. 2nd edition. Edward Arnold, London.

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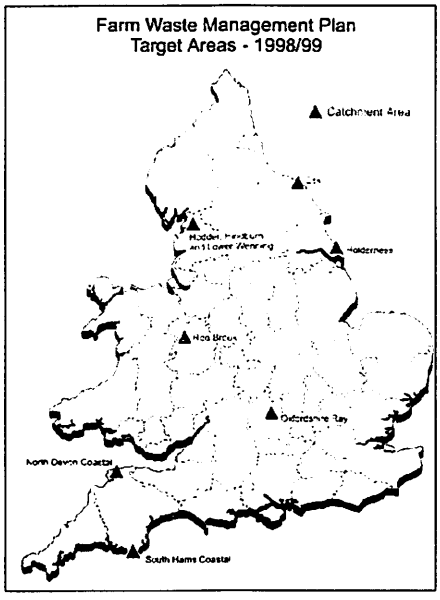
MAFF cleans up farm pollution

Up to 500 farmers in important river catchments in England are to be targeted under a new farm waste management initiative announced by Countryside Minister Elliot Morley. The £340,000 campaign gets under way in seven key river catchment areas where farmers will be encouraged to develop farm waste management plans to ensure good agricultural practice.

Farmers in each area will be supported and encouraged to prepare their own management plans for the spread of manure and other similar organic wastes on land in the most economical and environmentally friendly way.

The campaign started in 1992/93 and since then MAFF has funded farm waste management plans annually in selected river catchments in England. The plans will be crucial to establishing where, when, and in what quantities farmers should apply wastes in order to minimise water pollution and maximise benefits from nutrients in them.

The continuing fall in the number of water pollution incidents arising from agriculture demonstrates that farmers are more aware of their own environmental responsibilities and are taking the appropriate actions. Responses from farmers in previous campaigns have clearly shown that they recognise that following a farm waste management plan maximises the nutrient benefit from farm wastes while minimising the risk of water pollution. The message that we are trying to put across to farmers with the launch of this campaign is that good farm management practice will reduce farm pollution.



The new areas comprise part or all of the following river catchments:

the Rivers Hodder, Hindburn and Lower Wenning in Lancashire
the River Esk in North Yorkshire;
the River Holderness in Humberside;
the Rea Brook in Shropshire;
the River Ray in Oxfordshire;
the North Devon Coastal Strip; and
the South Hams Coastal Strip also in Devon.

A map showing the seven target areas is attached.

Branch Diary

Northern Ireland Branch

February 1999 Evening meeting
Venue: ARNI Hillsborough
The future of tractors
March 1999 Evening meeting
Annual General Meeting & trailer braking systems
Hon Sec: John Mawhinney Tel: 01232 685044

Scottish Branch

Wednesday, 20 January 1999 at 19.30 h
Venue: Royal Hotel, STIRLING
Members' night
Various members will speak on a selection of topics after a bar meal - note the venue change
February 1999
Date and venue to be announced
Annual Conference
Quality assurance in agricultural production
Convener - Dave Howat, SAC Auchincruive
Followed at 16.30 h by the *Annual General Meeting*
Hon Sec: G M Owen Tel: 01968 675943

S E Midlands Branch

Monday, 11 January 1999 at 19.30 h
Venue: Silsoe College, Dining Room
Research Papers
Relationship between composition, conformation and carcass quality in pigs
by David Abrutat, Silsoe Research Institute
The effect of soil structure on the movement and behaviour of pesticides
by Fiona Marsh, Silsoe College
Impact of tillage on crop water availability in semi-arid Zimbabwe
by Frans Bauke van der Meer, Silsoe Research Institute
Spray transport from moving booms
by Seamus Murphy, Silsoe College
Tracking field machinery to predict and target soil damage
by Terence Richards, Silsoe College
Machine vision for an autonomous agricultural vehicle
by Ben Southall, Silsoe Research Institute
Monday, 1 February 1999 at 19.00 h
Venue: Silsoe College, Englands Hall
History of the Great Ouse
by Walter Massey, Asst. Regional Engineer, MAFF
Joint Meeting with the Water Management Group
Monday, 1 March 1999 at 19.00 h
Venue: Silsoe Research Institute, Conference Room
Annual General Meeting
Followed by talk on:*Overseas Storage*
To be arranged
Hon Sec: M D P Matthews Tel: 01525 860000

Southern Branch

Wednesday, 18 February 1999 time to be advised
Location: Eastleigh, Southampton
Visit to Mr Kiplings Cakes
Tuesday, 10 March 1999 at 19.00 h
Venue: The Bunk, Curridge, Newbury, Berkshire
Annual General Meeting
Followed at 19.30 h by *Dinner and an after dinner address*
Note: Members, partners and guests are particularly welcome on this evening.
Hon Sec: 0 J H Statham Tel: 01865 782259

West Midlands Branch

Monday, 11 January 1999 at 19.30 h
Venue: Massey Ferguson Training School, Stareton, Stoneleigh
Case Quadtrack
by P Wade/S Smith
Concept of the high power, four-tracked vehicle
Monday, 8 February 1999 at 19.30 h*
Venue: Dalehouse Lane, Kenilworth
Precision instrumentation
by Gordon Chester of Proctor and Chester Measurements Ltd
A rare opportunity to visit the premises of this specialist company
Monday, 8 March 1999 at 19.30 h
Venue: Farm Energy Centre, National Agricultural Centre, Stoneleigh
Annual General Meeting
Followed at 20.00 h by talk on: *Biomass to energy*
by Roy Woodford, Farm Energy Centre Marketing Manager
*Numbers restricted, pre booking via Hon Sec essential
Hon Sec: M C Sheldon Tel: 01926 318333

Wrekin Branch

Monday, 18 January 1999 at 19.30 h
Venue: Harper Adams College
Power-shifting with a Fendt - a closer look at that bit under the driver
by speaker from AGCO to be confirmed.
Monday, 15 February 1999 at 19.30 h
Venue: Harper Adams College
Sludge & slurry - to spread or not to spread?
Two speakers to give each point of view: *for* - Bob Hardman, Severn Trent Water; *against* – to be confirmed.
Monday, 8 March 1999 at 19.30 h
Venue: Harper Adams College
Annual General Meeting
Followed by talk on: *Mechanised food production in the former Soviet States*
by Phil Metcalfe, ADAS Wolverhampton
Monday, 22 March 1999 at 19.30 h
Venue: Harper Adams College
Field testing & development, MF style
by Rob Oliver, AGCO/MF, Coventry
Hon Sec: Denis Cartmel Tel: 01785 712690

Triple link suspension for 7010 Series tractors

All three tractors in John Deere's 7010 Series range can now be fitted with the company's triple link suspension (TLS) system, as featured on the new 6010 Series range that made its European debut at the Agritechnica exhibition in Germany last November.

Available as an option on the 105 kW 7610, 116 kW 7710 and 131 kW 7810 tractors, the fully suspended front axle is permanently engaged, providing 100 mm of travel – 50 mm in either direction. This is designed to increase productivity by giving a more comfortable ride and better traction in the field, even when ploughing or using a front loader, as well as smoother performance on the road.

An electronic level control monitors and constantly centralises the axle suspension for extra efficiency and safety in operation. The system is said to be particularly effective when working at higher speeds, for example when cultivating, spreading or mowing.

Versatility of the tractor's hydraulic system has also been improved by the new option of factory installed fourth and fifth selective control valves (SCVS) with joystick controls.

Each 7010 Series tractor has a turbocharged PowerTech engine, which can deliver even greater performance above the rated power, giving maximum outputs of 107, 125 and 140 kW. In addition, each model develops a massive torque rise of up to 50 per cent at the pto, maintaining the extra power even at lower rpm.

The improved 19/7 40 km/h Powershift transmission incorporates computer control for smoother shifting, under all load conditions. Alternatively, a 20/20 40 km/h PowrQuad transmission is available for the 7710 and 7810, with the option of a left hand controlled power reverser for easier loader work and faster headland turns.

John Deere 7010 Series tractors are also available with the electronic headland management system (HMS). This allows automatic disengagement of the 4WD diff-lock and pto when raising the three-point hitch, making the driver's job that much easier when turning at headlands. Lowering the hitch will re-engage the diff-lock and 4WD, but in the interests of safety, the operator must re-engage the pto manually.

Basic prices of the John Deere 7010 Series tractors are 7610 Powershift £58,077, 7710 PowrQuad £58,872 and 7810 PowrQuad £64,271. The new TLS option adds a further £3868.

Contact: **Gordon Day, John Deere Limited. Tel: 01949 860491**

Sensor bearings bring AC motor technology to fork trucks

By using a bearing with a built-in electronic speed sensor, manufacturers of fork lift trucks are now able to use higher performing AC electric drive motors in preference to traditional DC drive.

The bearing, produced by SKF, the world's largest manufacturer of bearings, incorporates a 'Hall-effect' sensor to measure the rotational speed of the motor shaft. In one of its first industrial applications, the bearing has been installed in a new AC Superdrive motor control system developed for the latest range of forklift trucks from BT Industries of Sweden for both the main traction motor and the lift trucks' hydraulic pump motor.

The bearing generates an accurate feedback signal of the rotational speed which has enabled the company to adopt AC motors for its forklift trucks. Despite the simplicity and lower cost of AC induction motor drives, DC motors have dominated the forklift truck market until now because the cost of the control units for AC drives has been too high.

The bearing is based on a standard deep-groove ball bearing fitted with a magnetic impulse ring and two 'Hall-effect' sensor cells. The impulse ring is magnetised with 64 north and 64 south poles and, as they rotate, the poles develop a magnetic field which creates an electromagnetic field in the sensors. By using two sensors, the bearing can provide information on both speed and the direction of rotation.

The new AC Superdrive control system has been developed by Atlas Copco in conjunction with BT and electric motor manufacturer ELMO Industries. Fitting the bearing is very straightforward, requires no extra space and it is well protected inside the motor casing to provide a reliable, steady pulse signal.

Over the past 15 years, many industrial drive systems have converted from DC to electronically controlled AC drives because of their greater flexibility and the benefits of brushless operation. Despite falling AC motor costs and cheaper and more sophisticated power semiconductors, AC forklift truck control has remained too expensive.

However, with SKF's sensor bearing, the new control allows AC drive systems to match the cost of traditional DC drives while giving better performance.

Contact: **Chris Haywood SKF Industrial Sales Division, Sundon Park Road, Luton, Bedfordshire LU3 3BL. Tel: 01582 490049.**

Pneumatic seeder purpose-designed for sowing grass

A high-output pneumatic seeder designed to sow grass seed accurately and evenly at the optimum spacing and depth for healthy, vigorous establishment has been introduced by Staffordshire manufacturer, Turfmech Machinery Ltd.

Developed principally for use by specialist turf growers, the Turfmech Seed-Air 3000 uses Accord's proven cell-wheel metering and air-assisted seed delivery systems to ensure accurate, consistent sowing. Working width is 3m, giving the unit a potential workrate of 2.2 ha/h at a forward speed of 8 km/h. This makes the seeder ideal also for contractors, landscapers and farmers needing to reseed larger areas of grass for grazing, forage production, leisure or sport.

The Seed-Air 3000 comprises three main components: a rugged three-point linkage mounted frame; the seed hopper, metering device and pneumatic seed delivery assembly; and two full-width rows of notched cast iron press rings which create the seeding slots and then cover and firm the distributed seed within the soil.

In work, the entire weight of the seeder assembly and hopper is carried on the leading set of cast-iron rings, which are spaced to produce a compact row width of 25mm. Working on level, cultivated soil, the front rings create continuous grooves in the soil into which the calibrated seed is broadcast via 24 evenly-spaced delivery tubes. The seed is covered with soil immediately to a maximum depth of 12mm by the rear set of rings. Free-floating to maintain positive ground contact across the full working width, these rings produce a consistent firming action to ensure excellent seed to soil contact and moisture retention, both essential for optimum germination.

The Seed-Air 3000 from Turfmech is believed to be the world's first purpose-built seeder for the turf-growing industry to use Accord's acclaimed precision seed metering and air delivery system. Proven across tens of thousands of hectares in agriculture, the design combines gentle handling, highly accurate land-wheel metering and exceptionally even distribution of seed across the full working width. In trials, there has been little or no variation between pre-work calibration settings and the actual number of seeds sown per hectare.

Supplied with a 750 litre capacity hopper (extension sides available to raise capacity to 1,000 litres), the fully-mounted Seed-Air 3000 is designed for use behind tractors of 45 to 68 kW. A drawbar tow kit is available for those wishing to pull the unit behind tractors as small as 26 kW. Standard equipment includes a detachable rear-filling platform, a weather cover for the hopper and an area meter. Front roller scrapers and rear roller brushes can be specified to prevent soil or dust build-up in tricky soil conditions. Price of the new Turfmech Seed-Air 3000 is from £8,500.

Contact: **Austin Jarrett, Turfmech Machinery Ltd, New Road Industrial Estate, Hixon, Staffordshire ST18 0PJ. Tel: 01889 271503.**

New REVERSHIFT from Renault

Renault Agriculture has introduced a new change-under-load electrohydraulic reverser, which is available as an option on ARES 500 and 600 models.

REVERSHIFT can be used at all speeds within either of Renault's Twinshift, Quadrishift and creep speed transmissions. Unlike some, it is a true reverser, in that it will revert back to exactly the same speed as before the change of direction.

The REVERSHIFT control lever is mounted on the left hand side of the steering column, and can be easily operated whilst keeping hold of the steering wheel. For safety, the control incorporates three detented positions: forward, neutral and reverse. When selected, the position of the control lever is also indicated on the transmission readout on the dashboard.

In operation, whatever gear is engaged, the lever is simply moved without using the clutch. The operation is controlled by the ARES Drivetronic electronic control system, which automatically slows the tractor smoothly using hydraulic clutches, makes the chance of direction and then takes the tractor back up to the previous speed. Changes of direction can also be made in complete safety on slopes, such as when rolling silage.

Declutch facility

For further operator convenience, REVERSHIFT also incorporates a hand operated automatic clutch. When changing, gear or bringing, the tractor to a halt, declutching can be achieved simply by either lifting the REVERSHIFT control lever or, especially useful when changing gear, by holding down a button on the back of the gear lever knob.

Despite this facility, the tractor does still retain a fully operational clutch pedal, which can be used when hitching implements, but also provides psychological security for the driver.

The price of REVERSHIFT when fitted to either ARES 500 or 600 models is £800.

Contact: **Mike Clarke, Renault Agriculture Ltd, Shipston House, Darlingscote Road, Shipston-on-Stour, Warwickshire CV36 4DZ. Tel: 01608 662727.**

Innovation helps Sones Landscapes win £1.5 million contract

At the A74 upgrade project, Sones Landscapes is undertaking one of its largest ever single schemes, involving the maintenance of 72 km and new planting of over 600,000 transplants along 28 km of motorway embankment in a £1.5 million contract for the M6 Joint Venture Company acting for the Secretary of State for Scotland. Won against stiff national competition, Sones' tender was backed by the knowledge that a revolutionary new appliance, the SK Planting Machine, would soon be available for them to achieve tree and shrub planting rates previously only dreamt of by both forestry and landscaping contractors.

The machine, however, only made its debut on the 23rd of September at the APF (Association of Professional Foresters) International Forest Machinery Exhibition on the Aske Estate near Richmond in North Yorkshire, where interest surpassed all expectations, before being taken up to Glasgow to start work planting whips this coming season.

Bill Sones takes up the story, 'The original idea of an automated planting device came from Brian Keen who developed his prototype in the Scottish Borders specifically for forestry work. Large landscaping contracts for utilities and local authorities now require high planting rates to be profitable for contractors and I'd been looking for something to give us the edge in competitive tenders. We therefore formed a joint venture so that I could adapt his basic idea into a more sophisticated machine for landscape works and the SK (Mark II) was born.'

Basically a tractor drawn frame, the new device is able to plant double rows of transplants on slopes of up to 30 degrees and at rates of up to 2,500 per hour, compared to traditional manual rates of around 100/120 per hour. Two operators ride the machine on hydraulically operated swivel seats feeding the plants into twin trenches dug by magnesium steel ploughs which are then compacted by the rear steel rollers. The plants are fed from pre-mixed integral feeder trays whilst the operators are linked by intercom to both the tractor driver and back-up vehicles and protected by a safety roll cage. Optional accessories include offset frames and cultivator, weed killer and fertiliser attachments.

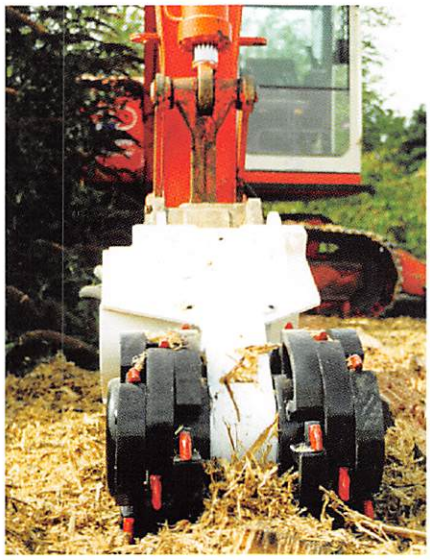
Bill Sones continued, 'The reaction from the forestry industry at Richmond was very encouraging with a steady flow of enquiries for contracting work. We're not intending to sell the machines, which are protected by patent applications, but rather gain more work for ourselves as landscaping and forestry contractors. It's been a lot of hard work to get it ready, but the potential is fantastic.'

For information on SK Planting Machines, contact: **Bill Sones on 0191 378 0645.**

STUMPED? Webster Schaeff have the answer!

The Rotherham, LTK-based engineering organisation, Webster Schaeff & Company, has successfully developed and produced a range of hydraulically driven Transverse Cutting Units (TCU) which now have considerable potential in forestry and agricultural applications thanks to their new woodcutting head.

This new development has been designed for cutting through wood, primarily for tree stump removal, in Forestry and agricultural applications. The wood cutting head, when mounted on a TCU makes light work of this traditionally arduous task. The new head removes the need for use of explosives, a traditional method of tree stump removal, making the whole process quicker, simpler & less hazardous.



The wood cutting drums have been specifically designed for the Webster Schaeff range of excavator mounted hydraulic cutting units, and are fully interchangeable with standard drums. Having a woodcutter mounted to an excavator will allow stumps to be removed from areas that would normally be inaccessible and also has the advantage of being able to use standard equipment.

The cutter picks are radial type with positive rake carbide and are readily available. When relying on the excavator boom movements to feed the WS-052 hydraulic cutting unit into the wood, stability problems can occur. For this reason the drums have an in-built cutter depth restriction to optimise cutting performance even with the excavator boom at full reach.

Contact: **William McIntyre. Tel: 0114 2463335.**

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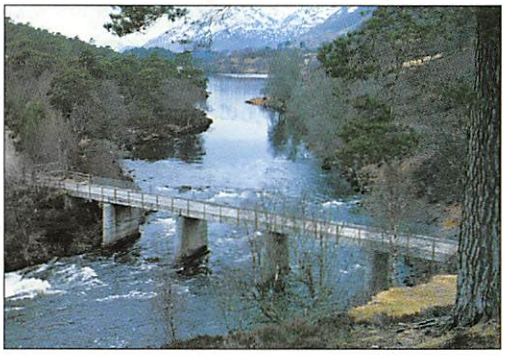

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