Light: Adding Value to a Steel Frame

Design guidance on lighting for livestock buildings has remained rudimentary for years. BS5502: part 40, (1990) states that natural lighting should be provided for cattle where possible, with supplementary artificial lighting where appropriate. Target light levels recommend 50 lux as standard service illumination and 300 lux for inspection. Similar guidance is given for sheep and pig buildings but with the comment that reproduction efficiency in sows is particularly sensitive to changes in day length (photoperiod). Knowledge of lighting requirements for poultry is more advanced than for other species, but even so the gap between was is required and what is delivered inside a building can be miles apart.

Lighting is an area where it is possible to add value to building design, but sales will only come if the added cost of added natural or artificial light can be justified by clear welfare/health/production benefits. The potential for getting better lighting control into livestock buildings is good because the baseline of knowledge is low, and the tools to provide on-site awareness are now very low cost.

The RIDBA Farm Buildings Handbook suggests 10-15% of the roof area as rooflights and mentions that whilst there are commercial pressures that support more rooflights, attention needs to be paid to solar gain. There was a trend in animal welfare dialogue 20 years ago that suggested that more natural light equalled more welfare benefits, and therefore that more rooflights equates to an improvement, but the facts are different. There are considerable benefits to be gained by “adequate lighting” but the negative impact of >10% rooflights on adult cattle kept inside in the summer months in the UK can have a negative influence on feed intakes and therefore yield, on the prevalence of environmental mastitis, and on financial returns. The design requirements are to take what is known, not opinion, and apply it to new and existing buildings.

The value of a controllable lighting system for cattle is based on clear scientific data that has shown that dairy cow fertility and milk yields are improved by a regime of 16 hours light, minimum 6 hours dark, per day. Furthermore, ‘light’ is >200 lux and ‘dark’ is <20 lux. Light meters cost £20-£30 and are simple to use, but I have never been on a farm where they are used by either the farmer or vets to solve problems. The facts are simple; incident light has biological impacts; light has quality and duration and can be measured; and nowhere in the UK has 16 hours of daylight 365 days a year. We need better lighting systems.

A lighting system that delivers minimum and maximum light levels across all the relevant floor area of a livestock building, automatically (remove human interference), will undoubtably cost more than a typical minimum farm building lighting system. But consider the benefits: if milk yields increase by 3% as a result of a 16 h >200lux: 6 h <20 lux lighting regime, a 300 cow herd producing 10,000 l per year would increase income by £22,500 p.a. The automation of lighting is essential, because dry cows, those resting in the last 60 days of pregnancy, benefit from a reduced photoperiod of 8 h light,16 dark which sees an improvement in immune function, a positive health benefit, and improved milk yield in the following lactation. An efficient livestock unit will have different light regimes according to the physiological needs of the different classes of animals. Natural light might have a good cost benefit ratio, but nowhere in the UK can natural light provide 16 hours at 200 lux inside a building. We need to sell the benefits of control.

Scientific studies looking at light regimes and young cattle are few, but unsurprisingly the results are similar to those seen in adult cattle. One study recorded a significant increase in growth rates from birth to 56 days, associated with increased dry feed intake in calves exposed to 600 lux on an 18 h light, 6 h dark photoperiod per day compared with calves on a 10h light, 14h dark photoperiod. A further study has shown a similar increase in calf feed intakes and a reduction in diarrhoea compared to calves on a shorter light period, with a system of 12 hours natural light supplemented with timed artificial light giving approximately 415 lumens at calf eye level. Calves on the longer lighting regime reached weaning weight quicker than those on the other treatments with no significant difference in total concentrate intakes and gave a 20% reduction in costs to weaning as a result of reduced labour, milk and medication costs. A study of calf facilities on 38 commercial farms reported an average 805 lux at the feeder, with a range of 9 to 20,000, and slightly higher at the calf resting area. There is profit for everyone in improving poor lighting systems.

The poultry industry has led the way on improved lighting systems for health and productivity gains, although application of knowledge on light quality and automated regimes still has market opportunity in the commercial sector. LED lighting systems may cost more to install than conventional fluorescent systems, but the ability to provide good light distribution produces an optimal distribution of birds across the floor, which minimises vice and health issues caused when birds congregate in preferred light areas. Equal light distribution minimises shadow formation which can impact on bird behaviour. LEDs are easy to dim and therefore provide a gradual change from ‘light’ to ‘dark’, and also provide high-frequency lighting. Poultry perceive light frequency below 160 hertz as a series of flashes; conventional fluorescent lighting may have a frequency of 50 hertz and will not provide a stable light environment.

There is a good future in light for livestock. Recent work has shown significant increases in Vitamin D3 content of milk from cows exposed to 30 min/d of UV for 12 weeks, which suggests that the wavelength of light is an area that should be investigated with regard to animal health. The impact of natural light on hygiene issues is mildly understood, for example with reference to the survival rate of airborne viruses and bacteria, and our ability to artificially provide lighting benefits will continue to increase. We do however need to keep an eye on potential negative issues. Light pollution in rural areas can and should be addressed at the design stage, not at a planning enquiry. Light fittings and maintenance should always acknowledge health and safety issues in an industry that has a poor record and attitude to such areas. And don’t forget solar gain; rooflights are excellent for the winter period but can be destructive in the summer. Hot cows don’t work. Keep cows cool, buy a light meter, and use it to create better buildings.

Written by RIDBA Technical Consultant, Jamie Robertson.