FEEDLOT SHADE SYSTEMS

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PREAMBLE

During the summer of 1991 the temperature at the Whyalla Cattle Feedlot near the Queensland border rose from 35°C at 9.00am to 45°C at midday. With the humidity at near 100% and no breeze the result was 2,500 beasts dead within five hours. The loss in monetary terms was $3.0 million plus.

As a result of this event the owners of the feedlot decided they would shade all pens. Several standard systems were proposed but were dismissed as not being suitable for the feedlot situation. After several meetings with the management and working staff at the feedlot a set of parameters was established. From these parameters the 'strip shade' system was evolved. Forty shade systems were installed by December 1991 and over the next few summers a total of 200 plus systems were installed covering some 50,000 animals.

DESIGN PHILOSOPHY

In order to design a shade system which would be effective and practical to suit the needs of a cattle feedlot situation, the following parameters were considered:

- Distribution of shade as opposed to concentration in one area.
- Adequate periods of sunlight to ground areas where the cattle will be concentrated.
- Minimum number of support columns.
- Minimum clearance height of 4 metres to facilitate the pen cleaning machinery and horse–mounted stockmen.
- Simplistic stressing system with a view to restressing.
- Minimal construction time for footing/columns and erection of the shade netting.

GENERAL DESCRIPTION

Each shade system consists of six strips of shademesh 30 metres by 3 metres with 1.8m gap between strips. The strips are tied together with a grid of wire cables across the gaps at 500mm centres. This provides a reasonable bi–directional stress state in the shade panels.

The system of 6 shade strips is tensioned via four curved edge cables and supported by four perimeter columns and a central support column. The edge cables span around 50m on average. Three of the four perimeter columns are located on the fence line with the fourth perimeter column located some distance back from the feeding troughs. The central column is adjustable to allow for initial stressing of the shademesh/cable system.

Stressing is important to limit deflection under wind load and to avoid the flapping motion which reduces the membrane life. Final tensioning this shade system is easily achieved with chain blocks on two support column corners only. This simple method of tensioning is important because the polyethylene knitted material will creep over a period of time and restressing is required.

GENERAL FEATURES

The strips distribute shade over a large area of the pen and this ensures that the cattle are constantly moving during the day with the shade. In addition to:

- Reduction of the effect of group body heat as opposed to when animals congregate under a single large block of shade.
- The geometry of the shade maximises the sunlight time on the pen surface to reduce the creation of a 'bog' problem associated with animal waste.
- The shade strips create a convection current effect which has a significant cooling effect on the hot still days.
- The alleys of sunlight between the shade allow the cattle easy access to and from the feed and water.
- Fence–line located support columns allow for minimum interference to cattle movement and pen cleaning.

SHADE MATERIAL

The shade material was a warp knitted high density polyethylene 320gsm shademesh. The yarn has carbon black with UV stabilisers to give an effective life of 8–10 years. Accelerated weathering test at the University of Queensland showed no degradation of the monofilament at the 10 year mark, unfortunately the test was cancelled at this stage. The basis UV stabilising chemicals were provide by CIBA GEIGY to Boral Kinnears Pty Ltd who produce the yarn. The shademesh was knitted by Netting Australia at their Yamanto Plant near Brisbane.

It should be noted that the self–locking warp knit will minimise tear propagation from either intentional or accidental damage. A simple needle and thread can repair any tear on site to a very neat and acceptable standard. This is not the case with conventional woven shade cloths which tends to run when tears occur.

DESIGN

The shade system was modelled on a three dimensional finite element program by McWilliam Consulting Engineers. The major design decision was to establish the wind loads porosity of the shademesh. There had been little or no data published on the effect of wind loads on horizontal panels of knitted open weave material, certainly nothing which would help with this configuration. It was decided on the basis of experience, assumption and calculations of vertical wind movement through the panels that the design wind speed of 27m/sec would result in a design pressure of $\pm$ 0.08kPa on the design model. Coincident with this is a component of horizontal drag due to the undulating movement of the panels. This in turn resulted in a maximum calculated corner load on the edge cables of 33KN.

To confirm these design assumptions a load cell was installed on a corner connection of a shade system in the direction of the main prevailing winds. An on site anemometer was located some 150 metres away. During the summer of 1992/93 a maximum average wind speed of 16m/sec was recorded. This would equate to wind gusts of some 24m/sec. The maximum load cell reading was 35KN.

Also it should be noted that to confirm detailing and prestress conditions a full scale (46m.square) strip shade system was erected and tested prior to full production.

DETAILING

Each shade panel was edged with rope and twine manufactured from the same black polyethylene thread as used in the knitted shademesh. This would ensure there would be no differential degradation of the shademesh, rope edge or sewing twine.

The intermediate wires were connected to the shademesh via a PVC clip and to the edge cables via a metal clamping clip. All other connections used simple standard shackle/thimble rope grip detailing.

PERFORMANCE

Since first installation the 200 or so pen systems have performed their intended function well as measured by operator monitoring of cattle health and weight gain.

As with any new 'product' form. continuing development of layout and detail has been undertaken. Physical performance has, however, been very satisfying and less provided a high degree of confidence in engineering of these and similar large span shade mesh structures.

Finally it should be noted that this design has been recognised by the University of Queensland, Queensland department of Primary Industry and the recent Federal Government enquiry into the beef feedlot industry as being the ideal solution to feedlot shade.

Photographs not available (May 2006)

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