

3D Feed Pen Layout



FEEDLOT DESIGN AND CONSTRUCTION

9. Overall pen layout

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Introduction

The production pens are the main animal housing unit for a cattle feedlot. Sound design will ensure optimum animal performance, good animal welfare and high standards of environmental performance.

Design objectives

The design objectives for a feedlot production pen are to

- provide an environment for cattle where production performance and animal welfare are maximised
- promote safe access for cattle to and from the pen
- minimise environmental impacts such as odour and dust
- promote drainage to provide a comfortable environment for cattle and minimise environmental impact
- optimise the management and removal of manure from the pens
- minimise ongoing maintenance costs
- provide a safe working environment for pen riders and other feedlot personnel.



Pen design choices



Mandatory requirements

Apart from pen slope and pen floor permeability, the National Guidelines do not provide any specific design requirements for production pens. Pen slope is addressed in *Section 10 – Pens and drainage systems*, and pen floor permeability is discussed in *Section 8 – Bulk earthworks*.

The National Feedlot Code of Practice recommends a maximum stocking area of 25 m² per Standard Cattle Unit (SCU). In circumstances where a feedlot operates at a lower stocking area (>25 m² per SCU) the feedlot manager is responsible for justifying the greater density and for obtaining approval from the appropriate authority. Stocking areas lower than 20 m² per SCU can encourage increased pen dust loads and require higher capacity for sedimentation and holding ponds.

The Australian Animal Welfare Standards and Guidelines for Cattle (DAFF, 2013) state

S10.1 A person in charge must ensure a minimum area of 9 m² per Standard Cattle Unit for cattle held in external pens.

G10.10 Feed yard facilities should comply with the requirements of the National Beef Cattle Feedlot Environmental Code of Practice, 2nd Edition, as amended or superseded.

Design choices

Once a particular feedlot layout has been chosen, the next step is pen design (see Figure 1). Factors requiring consideration include

- stocking density
- bunk space per head
- pen slope
- pen head capacity
- access to the pen
- provision for shade, if required.

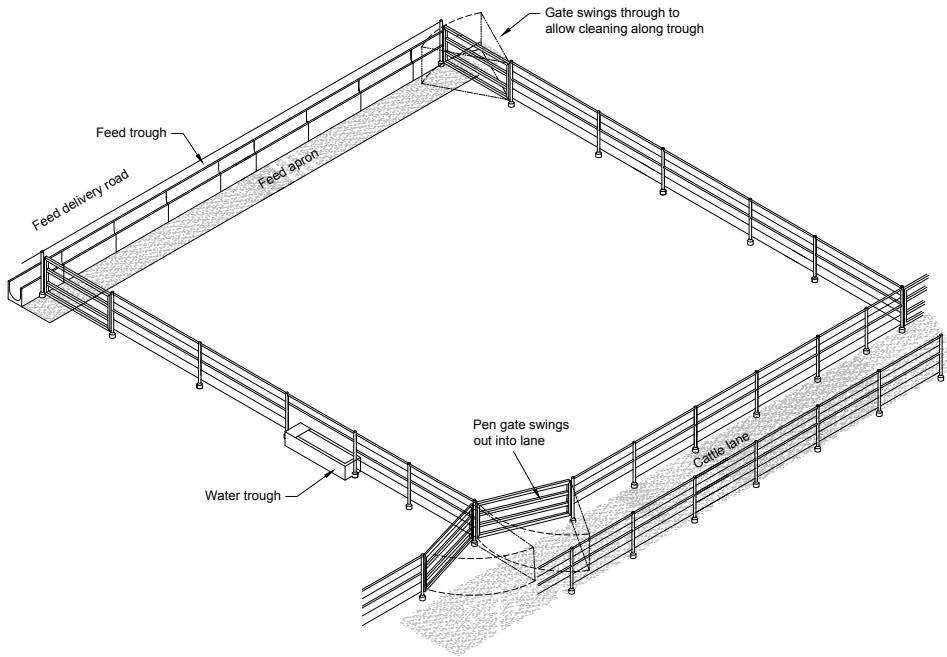


Figure 1. Production pen design parameters

The dimensions of a feed pen depend on the capacity of the pen, stocking density and the amount of feed bunk required. Figure 2 shows how stocking density (SD), feed bunk length (FBL) and pen capacity relate to the dimensions of a typical feedlot pen.

Pen dimensions

Pen dimensions are determined by the combination of stocking density, bunk length per head and pen capacity as per the figure below.

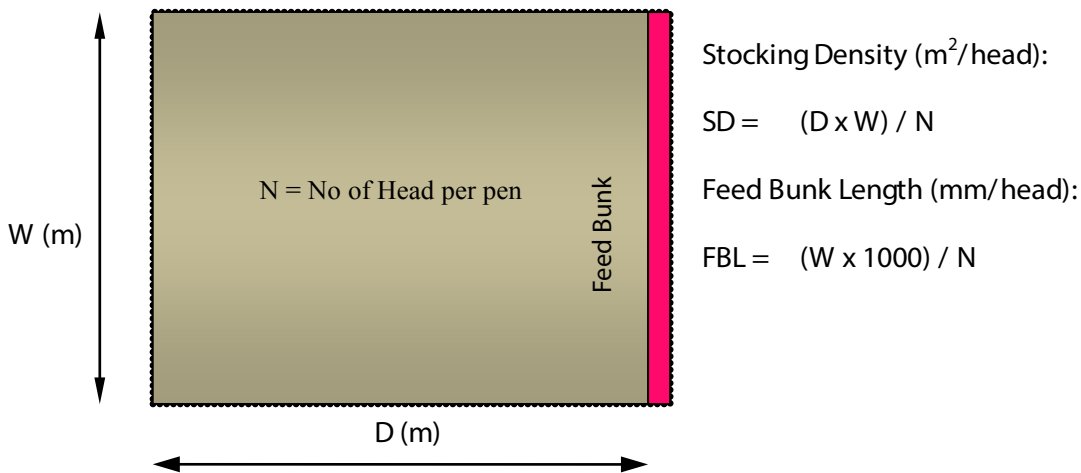


Figure 2. Pen dimensions

The following tables show the different dimensions for 100, 150 and 200 SCU pens as affected by stocking density and bunk space per head. Pens with smaller capacities can be narrow, presenting problems for the use of pen cleaning machinery.



Wet winters are an issue for stocking density, particularly with winter-dominant rainfall.

Table 1. Pen dimensions for a 100 SCU pen

Stocking density (m ²)	10		15		20	
Bunk space (mm/head)	250	300	250	300	250	300
Width, W (m)	25.0	30.0	25.0	30.0	25.0	30.0
Depth, D (m)	40.0	33.3	60.0	50.0	80.0	66.7

Table 2. Pen dimensions for a 150 SCU pen

Stocking density (m ²)	10		15		20	
Bunk space (mm/head)	250	300	250	300	250	300
Width, W (m)	37.5	45.0	37.5	45.0	37.5	45.0
Depth, D (m)	40.0	33.3	60.0	50.0	80.0	66.7

Table 3. Pen dimensions for a 200 SCU pen

Stocking density (m ²)	10		15		20	
Bunk space (mm/head)	250	300	250	300	250	300
Width, W (m)	50.0	60.0	50.0	60.0	50.0	60.0
Depth, D (m)	40.0	33.3	60.0	50.0	80.0	66.7



Low stocking densities under low rainfall conditions can lead to dust, especially in the late afternoon.

Stocking density

Stocking density has a significant influence on the environmental performance of a feedlot since it partly determines the average moisture content of the pad. Every day, cattle add moisture to the pen surface by manure (faeces and urine) deposition.

Figure 3 shows the estimated moisture added to the pen surface each year for cattle of various weights kept at different stocking densities.

This simple calculation assumes that cattle excrete 5% of their liveweight each day and manure is 90% moisture. Heavy cattle (750 kg) at 10 m²/head can add over 1200 mm of moisture per year (3.3 mm/day). During winter, if this exceeds the evaporation rate (depending on location) the pad remains moist, and odour and cattle comfort problems can develop. On the other hand, light cattle kept at 20 m²/head contribute less than 1 mm of moisture/day. In summer, evaporation readily removes this moisture and dust can become a problem.

The choice of stocking density to achieve a balance between a pen surface that is too dry and one that is too wet depends on local climate and cattle size.

Following the USA example, feedlots in Australia initially stocked pens at about 10 m²/head but experience has shown that this stocking density is appropriate only in drier zones (annual rainfall <500 mm/yr). For most feedlots in the grain belt, a stocking density of about 15 m²/head achieves an optimum outcome for cattle, pen environment and pen maintenance.

The effect of added moisture is a particular issue for covered feedlots where, for economic reasons, stocking densities are high (around 2.5–6 m²/head). See Section 44 – Covered housing systems.

Even though rainfall is excluded, the added moisture can exceed 2000 mm/year and pen surfaces quickly become wet. Under these circumstances, a bedding material must be used to absorb the moisture and this bedding should be removed every few weeks.

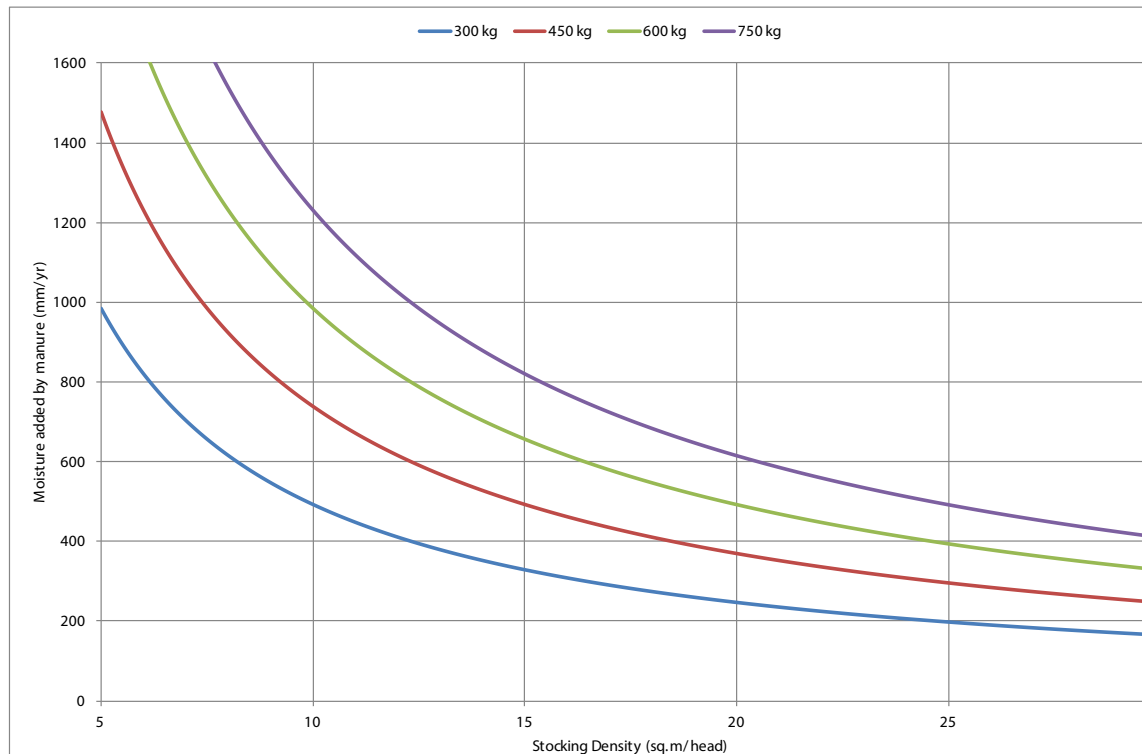


Figure 3. Effect of stocking density and cattle liveweight on moisture added to pen surface

Feed bunk space (per head)

The length of bunk space required per head is discussed in *Section 19 – Feeding systems*. Typically, this is in the range of 200 mm/head to over 300 mm/head.

Pen capacity (no. of head)

It is convenient to size pens to match multiples of deck sizes of livestock transport vehicles. A double deck semi-trailer would carry about twenty-six 450 kg cattle per deck giving a total load of 52 head. (Refer to the Land Transport Standards and Guidelines for loading densities of cattle on livestock transport vehicles. DAFF, 2013). A B-double load would be approximately seventy-eight 450 kg cattle.

Many commercial feedlots have a range of pen sizes from 50 head to 300 head. In custom feeding operations, a variety of pen sizes allows management to cater optimally for different sized customer consignments. When large consignments of cattle are fed, poor performers may be drafted off during the feeding period and may end up in 50 and 100 head pens before a quick sale. Many managers prefer to hold cattle in 80–100 head group sizes prior to trucking and/or container (carcase beef) lots depending on the combined weights of each consignment. The smaller pens are generally located closer to the cattle receipt and dispatch facilities.



A range of pen sizes allows management to cater for different sized consignments.



Trees left in pens invariably die, and are difficult to clean around.



All pens should have signs noting the pen number. This sign configuration allows pen number to be read by both feed truck operators in the feed alley and pen riders in the back of the pen.

Pen slope

Section 10 - Pens and drainage systems discusses the selection of appropriate pen slope.

Pen orientation

If shade is to be installed at the feedlot, pen orientation can be important. Rows of pens running north-south generally make the design of shade structures easier. This is discussed in *Section 16 - Shade*.

Water trough location

The many options for locating water troughs in pens are discussed in *Section 20 - Water trough design and sewer systems*.

Each pen should preferably have access to two water troughs so that cattle can have access to water if one trough blocks. Water troughs can be placed in a subdivision fence line or in the rear centre of the pen.

Obstructions in pens

Obstructions within pens should be as few as possible as they interfere with cattle movement, pen cleaning machinery and good pen drainage. Trees should not be left in pens as they invariably die and are difficult to clean around.

Signage

All pens should have a small sign with the pen number. This sign should be at the top end of the pen along the feed bunk so that feed truck operators can locate the correct pen when delivering feed. It is also useful to be able to identify the pen number from the cattle lane with another sign on the entrance gate from the stock lane to the pen.

Further reading

National Guidelines for Beef Cattle Feedlots in Australia - 3rd Edition, Feedlot Industry Accreditation Committee (ed.), June 2012, Meat & Livestock Australia, Sydney, NSW.

DAFF, 2013, Australian Animal Welfare Standards and Guidelines for the Land Transport of Livestock, Department of Agriculture, Forestry and Fisheries, Australian Government, Canberra, ACT.

DAFF, 2013, Australian Animal Standards and Guidelines for Cattle, Department of Agriculture, Forestry and Fisheries, Australian Government, Canberra, ACT.

Guidelines for the establishment and operation of cattle feedlots in South Australia, Department of Primary Industries and Resources (SA) and Environment Protection Authority, 2006, Adelaide.

Victorian code for cattle feedlots, August 1995, Victorian Feedlot Committee, Department of Agriculture, Energy & Minerals, Melbourne.

Skerman, A 2000, Reference manual for the establishment and operation of beef cattle feedlots in Queensland, Information Series QI99070, Queensland Cattle Feedlot Advisory Committee (FLAC), Department of Primary Industries, Toowoomba, QLD.

Guidelines for the Environmental Management of Beef Cattle Feedlots in Western Australia, Bulletin 4550, 2002, WADo Agriculture (ed.), Western Australia Department of Agriculture, Perth, WA.

The New South Wales feedlot manual, 1997, NSW Agriculture, NSW Agriculture, Department of Land and Water Conservation, Department of Urban Affairs and Planning & Environment Protection Authority, Orange.