Designing for better cow flow

1. Introduction

Milking is a complex process involving interactions between the cows, people and facilities. All of these elements are equally important and impact on one another. This Quick Note describes the key principles of physical dairy design shown to be important in improving cow flow in Australian milk harvesting systems.

2. Interpretation and relevance to Australian conditions

Good cow flow is important if the shed is to maintain its expected performance. In Australia and New Zealand where large herds are milked with minimum labour, good cow flow is much more important than in countries where paid labour is cheap or where small herds are milked.

3. Relationship to CowTime goals

Leaving the pit to fetch cows onto the platform is a significant drain on the operator's time and leads to lower labour productivity in milking. Facilities that allow cows to move easily through the milking system, with minimal human interaction, make for pleasant milking for both cows and operators. Conversely facilities that make it difficult for cows to move through the dairy upset both cows and operators, sometimes leading to additional persuasion being used which often makes the cows less inclined to enter the dairy.

4. Features that promote good cow flow

Entrance to the milking dairy

Ideally the cows should be in a calm, relaxed state immediately before they are milked.
Cows mill around less in the holding yard if they enter the yard at the end furthest away from the dairy. Cows enter the milking shed more easily if they enter in a straight line without turns, steps, ramps or changes in level. If a change in direction is necessary, it is usually better to have it on the cow exit rather than the entry. Steps more than 150mm high, and slopes more than 6%, have been associated with increased lameness. Cows tend to stand facing the dairy and cow flow is improved if the yard slopes upwards (not downwards) towards the dairy particularly for the last 3-4m leading up to the platform.

Dairy entries are usually designed with the yard tapering in smoothly to the dairy for either herringbone or rotary. Angles in the fence line should be minimized (preferably not greater than 45^{o}) and it may be an advantage to make the fences in the funneled area solid, particularly when the exit races are close.

The actual entrance race to the cow platform should be 1 cow wide (760-820mm) wide so that just one cow is able to enter at a time. In herringbone dairies, an entrance race seems to reduce the jostling for position near the milking platform, keeps cows in the yard away from the feed troughs and reduces the tendency for cows to turn back after entering. In rotary dairies, an entrance race allows a period for the cow to prepare herself to enter the platform (and perhaps begin milk letdown) untroubled by her herd mates. Many new rotary dairies are built with entrance races of two or more cow lengths (4m or more in length). Longer entrance races also facilitate the installation and reliable operation of electronic cow identification equipment both in herringbones and rotary dairies.

The milking platform

The milking shed should provide a comfortable environment for both the cows and the operator. Cows enter a well-lit open milking facility more easily than a closed-in dark facility.

Two schools of thought currently affect stall design, particularly in herringbones. One school suggests that the cow flow is improved on wide cow platforms without restrictions imposed by stall gates or zig-zag rails. Many of the earlier close-spaced herringbone systems were designed following this doctrine and did provide acceptable performance particularly in seasonal calving herds without in-bail feeding. Such systems worked best when the platforms were filled by a variable number of cows (only those which came in easily) and had the advantage that a heifer being trained could be easily restrained between two older cows. However, the cows tended not to stand close to the exit gate making it difficult to get the full number of cows on to the platform and cows not standing in the correct position often compromised cluster positioning.

An opposing and more recent school of thought suggests almost exactly the opposite design. Zigzag rails, dividers in the feed troughs, stall gates or individual stalls (on a rotary) are provided which may potentially restrict cow flow

but provide a consistent and repeatable environment from day to day. Crowding, bullying and competition for in-bail feed are reduced with these systems. Animal behaviour studies suggest that cows fear novelty and are more at ease in milking systems that provide a consistent environment. If the cows are relaxed during milking, operators will tend to relax and will need to use less force to persuade cows to cooperate. Consequently the cows will be more ready to enter the dairy and less likely to disrupt the milking routine.

The turnstyle rotary and herringbone systems with stall gates are good examples of milking systems designed to provide a constant and repeatable environment during milking. Stall gates also block off the feed troughs during exit so that the tendency for cows to linger in the dairy licking at feed residues is reduced.

Cow Exit

Straight exits without turns are preferred in conventional exit herringbones, with the exiting cows in view of the waiting cows to encourage them to follow them onto the platform. However, if a turn is required it is preferable to place the turn at the exit rather than the entry to a herringbone platform.
Large changes in level are best avoided and there is some evidence that cows move better down ramps rather than steps, but slope of the ramp should not exceed 6%.

If a turn is necessary on the exit from a herringbone, a clear 3m should be provided between the end of the pit and the wall or fence. Exit lanes should be at least 2.5m wide unless a narrower race is required for drafting, drenching or cow treatment. If the cows need to exit from a herringbone through a narrow race or other restriction, a waiting area should be provided. It should have sufficient capacity to hold at least one side of cows as they leave the herringbone.

On turnstyle rotaries, the exit area needs to provide sufficient area for the cows to step off and turn around before entering the exit lane. Usually an area at least 2.5 stalls wide and 3.0m deep is needed.

Conventional herringbone dairy

A conventional exit from the end of a herringbone has been the traditional system.

Advantages	**Disadvantages**
Simple to construct	Slows cow exit
Low cost	
Keeps the cows in one group	
Makes drafting easy	

Rapid exit herringbone dairy

Rapid exit systems allow the cows to exit through the side of the platform under feed troughs and breast rails (which move vertically out of the way).

Advantages*	**Disadvantages**
Batch exit under 25 seconds	Complicated mechanically – safety hazard
Usually comes with stall gates	May split the herd due to two exit points
	Complicates drafting

*The advantages of the rapid exit system are marginal in dairies under 12-a-side.

Rotary dairy

Australian turnstyle rotary dairies are now mature designs, having evolved for over 30 years. They usually offer very good cow flow with a very relaxed milking environment for the cow. The earlier steel designs were noisy and prone to corrosion but the later concrete platforms are quiet and durable. Modern automated milking equipment has made it possible to operate large rotary dairies (50 bails or more) single handed with excellent results in labour efficiency. While rotary dairies are good for cow flow they do not allow much time for cow preparation. Milk let-down (ejection) may be compromised unless the cups on operator is moved several stall positions away from the cow entry position. At high platform speeds, relocating the cups on operator could have the potential to reduce throughput and labour efficiency. In practice, however, the differences in cow throughput are usually negligible.

5. Potential challenges with implementation

Good cow flow through a dairy is a challenge for the cows, the milking operator and the facilities. Good performance will not eventuate unless all three factors are in balance. For this reason, it is possible that some of the design features discussed here will not provide the expected outcome because other factors may not be operating effectively. For example, a good operator handling cows with little fear of humans may find some of the design considerations mentioned here unimportant and vice versa.

6. Robustness of the information

Almost none of the design considerations considered important in achieving good cow flow are the result of traditional scientific experimentation of any kind. While many have been proven to work practically, the ideas are continually changing. Furthermore, design trends tend to run in cycles and some ideas get incorporated into dairies

because they are popular in that district at that time or because nothing else is readily available. For example, the performance being achieved in herringbone dairies equipped with stall gates tends to suggest that some of the earlier ideas that wide platforms are necessary for good cow flow were either incorrect or used in the wrong context. For this reason, the information presented is reasonably robust but cannot be guaranteed to remain unchanged in the future.

7. References and further reading

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CowTime Guidelines for milk harvesting - Chapters 2, 3, 4 & 5, edited by Klindworth, D. et al (2003). Available on the CowTime website www.cowtime.com.au

Quick Note 1.1: Cow behaviour and milk let-down

Quick Note 1.2: Cow handling – interactions between people and cows

Quick Note 1.3: Key factors to ensure a calm, consistent milking routine