Engineered Management in Housing

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Two titles were considered for this paper, "Engineered Management in Housing" and "Free Stalls and Cattle Health/Comfort." Being somewhat self-conscious about talking to veterinarians about health, the author chose the first title. Light (1973) defined engineered management as "...the process of physical design of individual elements of any housing system to have them function in accord with management decisions." He further indicated that the decisions made during the design of a housing system affects how the system will function. The designer, through the ultimate design, imposes upon the operation of the unit a set of management routines which will have to be followed for the life of the unit; management has been "engineered" into the system (or out of it). In simple terms, this paper will discuss observations as to the affect of barn design and construction on the health and well-being of animals and your ability to keep them healthy.

The fact that an engineer is invited to discuss barn design as relates to health with veterinarians is indicative of the continuing trend of looking at the overall livestock system rather than components. As more and more dairy farmers adopt comprehensive health management programs, it's my hope that more comprehensive planning of cattle facilities from a health standpoint will also occur. The team approach of manager, engineer, veterinarian, nutritionist, and builder should provide the best end product. It is important that the contributions of all of these individuals be considered. Just like quality health care requires careful planning and execution, so does quality barn design and construction. Veterinarians need to be aware of how building design and construction affect their role, but should not be lulled into thinking they can also be engineers. Thompson (1974) states "Engineering can play a significant role in specifying and achieving a healthful environment."

It is important to remember that every building project on the farm has a designer. This may be a competent engineer, or the builder's helper, who was told to "build a pen over there, and be sure it's done by this afternoon!" The successful designer must receive input from all users of a system, combine this with existing knowledge and expeience, and ultimately assure that the final product fulfills all the objectives intended. Baxter, in his introductory paper "Biology into Buildings" at the Farm Animal Housing and Welfare Conference in Aberdeen, Scotland in 1982, discusses the dilemma of the designer-client relationship. He states that while the stock person and the cow are the most regular users of a dairy facility, they are not always the ones with the most input into design and construction. Too often tradition, sanitary regulations, desire to cut costs, or do things the easy way gets in the way of providing a product that is best suited for the end users. The practicing veterinarian should be in a good position to "represent the cow" in these discussions.

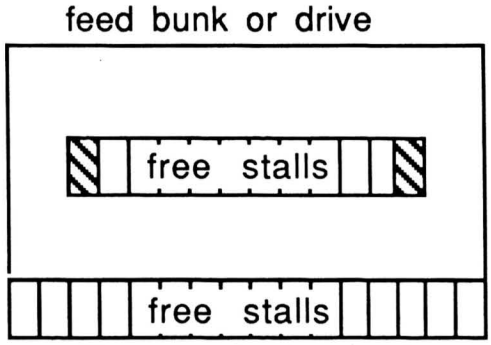
This paper will point out how various components of the free stall housing system can affect cow comfort, health, and productivity and serve as a checklist for items to look at from a health management standpoint. Anyone concerned with free stall housing should be familiar with the Proceedings from the Dairy Free Stall Housing Symposium held in January 1986. They contain experiences of farmers, farm advisors, engineers, designers, dairy and animal scientists, veterinarians, and suppliers during the 25 years that free stall housing has been used for dairy cattle.

How can building design affect management? Examples can include: feeding methods and space, dead end alleys, gates hinged to swing the wrong direction, inability to segregate animals for treatment, too narrow feed alleys for animal access, inability to move groups of cows to and from the milking center without having to go through other groups, turns required when scraping manure, excessive opening of gates while scraping manure or feeding, protrusions into the animal area causing injury to cattle, and absence of pass-throughs for personnel (Light, 1973).

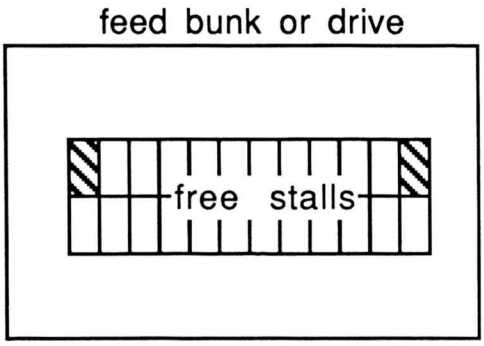
A simple example might be taken from typical free stall layouts. Two rows of free stalls arranged along a fence line feeder are very common (Graves, 1986). There are two alternative free stall positions: two rows of stalls along a scrape alley or two rows facing each other. Both layouts are very functional, provide ease of feeding and manure scraping, and allow the same amount of feed bunk space per stall.

Consider the following principles:

- Feed space is proportional to stall numbers. Addition of two more stalls (4′ of building length) results in 4 feet more of feeding space.
- The two long alleys provide easy manure scraping.
- The drive-along feed bunk is easily serviced from truck or wagon without driving among animals.
- The feed alley provides a convenient clean space for animal observation. Cross alleys and water at both ends,



Two rows back to back



Two Rows facing

or spaced along longer barns, provide easy access to feed, water, and free stalls.

- Gates located at cross alleys can lock cows along the feed bunk or in the back alley.

However, cows cannot be kept away from free stall areas in the arrangement with stalls facing each other. With separate alleys for feeding and resting it is a simple matter to lock cows in the feed alley away from all free stalls. Therefore, one who considers it important to keep animals from lying down immediately after milking should consider the final arrangement. Also, the facing arrangement results in only half as many stalls for animals if they are locked along the back alley to facilitate other barn operations.

Arguments relating to cow comfort can be made for either arrangement. Stalls along an outside wall may be less desirable during hot days due to sunlight penetration. On the other hand, facing stalls tend to concentrate animals and, therefore, animal heat in the center of the barn. Pennington (1982) refers to two environments in the housing system, biological (feed, water, parasites, and disease) and physical (climate, space, and shelter). Managerial environment (attitude, skills and knowledge) can be added to this list. It appears to me that housing system design and construction can impinge on all of these areas.

Graves and Light (1980) state that handling, moving, and treating cows is probably the most difficult materials handling problem on dairy farms, and that cows are continuously being "handled." This area needs careful consideration when selecting a housing system design. Cows are moved in groups or as individuals between milking, feeding, resting, and treatment areas. The following principles for animal handling and movement were presented, predicated by the reminder that "given a chance a cow will usually go the wrong way."

- Normal animal handling and movement should interfere as little as possible with other routine chore operations, such as feeding, milking, or barn cleaning.
- Ideally, one person should be able to safely move one cow, or a goup of cows, in and around the dairy complex with a minimum of commotion and frustration for the person or animals.
- One person should be able to isolate **and restrain** a cow for observation and treatment safely and conveniently.
- Animal movement lanes should provide for direct flow, free of obstructions, catch points, and alterntive paths of travel; sized to consider throughput of animals desired, turning and blocking by animals, and ease of cleaning.
- Construction should be sufficiently strong to withstand abuse by 1500-pound cows and equipment operators.
- Lighting should provide for 24-hour operation.
- Flexibility in allowable usage of specific handling facilities is desirable.
- Keep the system as simple as possible.
- Animal handling problems increase in direct proportion to herd size.

Anderson (1938) and Graves (1983a) stress the importance of allowing for adequate observation and treatment of animals in housing systems. Dairy farmers and those working with them are becoming increasingly aware of the importance of providing good health care facilities (Graves, 1983b and Hoard's Dairyman, 1982).

The Northeast Dairy Practices Council (1980) considers the following functional components of a free stall housing system: resting (free stalls), feeding, waterers, alleys, holding area, milking center, treatment and maternity area, and manure handling. Ventilation and layout should be added to this list. The following outline can serve as a reminder of items to consider when planning a free stall housing system.

Check List for Free Stall Housing Systems

Ventilation
- Mechanical
  - Exhaust fans—size and number.
  - Circulating fans.
  - Inlets
  - Thermostats
    - Location
    - Settings
  - Thermometer
- Natural
  - Cold weather openings

- Eaves
- Ridge
- Hot weather openings
  - 50-100% of sidewalls
  - cow level.
- Insulation
  - Moisture proof
  - Vapor barrier
  - Bird protection
- Hot Weather Plans
  - Adequate openings and/or ventilation rates
  - Roof insulation/material/color
  - High speed air movement (2-5 mph)
  - Evaporative cooling
  - Drinking water—amount, locations, termperature.
  - Shade
  - Animal density
  - Frequent manure removal

Layout

- Grouping
  - Number of groups
  - Animals per group
- Animal traffic patterns
- Manure removal/method/patterns
- Feeding methods/areas
- Flexibility
  - Size, number of groups

Free Stalls

- Number
- Size
- Base
  - Material
  - Slope
- Bedding
  - Type
  - Ease of delivery
- Partition
- Appurtenances
  - Training rails
  - Brisket boards
  - Bedding keepers
  - Bedding boards

Feeding

- Silage
- Hay
- Grain
- Lockups at feed bunk
- Bunk height
- Sanitary step
- Smooth acid resistant bunk floor
- Group feeding
- Computer feeders

Waterers

- Adequate
  - Number
  - Location
- Frost proof
- Shaded
- Sanitary step

Alleys

- Surface
  - Quality concrete
  - Anti-skid
    - Grooves ⅜-½″ deep and wide in 6-8″ diamond pattern
    - Alternative skid proofing
- Access to ends of alleys
- Width (NDPC 1, 1980)

Description	Width	
	Minimum	Recommended
Man pass	10″	12″
Single cow, one direction	32″	34″
Two cows, one direction	5″	6′
Two cows, two directions	6′	8′
Between free stall rows	6′	8′
Feed bunk to wall	10′	12′
Feed bunk to free stall	10′	12′
Drive through alley plus mangers	15′	16′
For 90 degree turn with tractor & scraper	16′	20′
For 90 degree turn with tractor & wagon	20′	24′

Holding area

- Matches group size
- Hot weather cooling (fans, openings, sprinklers)
- Shaded
- 1-2 hour maximum standing time
- Anti-skid surface
- Manure removal
- Common parlor holding area

Milking center

- Size and throughput consistent with group size
- Floor surface-anti-skid/cleanable
- Straight-in entry
- Access from operator pit to holding area
- Milking system
- Minimum traffic through milkroom
- Office
- Utilities
- Rest rooms
- Employee lounge

Treatment area

- Location
  - Cow traffic—parlor and barns
  - Access by veterinary vehicle
  - Records/water/supplies
  - Removal of downed animals
- Adequate restraining devices
- Lighting
- Convalescent pens separate from maternity

12'x12' minimum
Animal restraint in each pen
Anti-skid surface
Feed space and delivery method
Water
Clean out

Maternity area
Separate from treatment/convalescence area
12'x12' pens
Animal restraint in each pen
Anti-skid surface
Lifting device in each pen
Convenient for observation
Removal of downed animals
Lighting

Manure handling
Appropriate for climate
Minimum disruption of animals
Regular removal (at least daily)
Fly and rodent control

A well designed barn cannot replace good management. However, careful planning should result in a dairy housing system that promotes and encourages good management. Whenever possible, flexibility should be designed into the barn to accommodate alternative management methods.

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