



## Designing and Building Dairy Cattle Freestalls

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A dairy cow freestall (cubicle) provides dairy cows with a clean dry comfortable place to lie down and rest. The cow is not restrained in the stall but is free to enter and leave as she likes. Feed and water are not provided in the freestall. A cow desiring to eat or drink leaves the freestall and walks to another area in the freestall barn. A well designed and properly maintained freestall is the key component in a dairy freestall housing system.

A freestall should provide comfort, promote cleanliness, and prevent injuries to the cow. It must provide enough room for the largest cow in the herd to freely enter, lie down, rest comfortably, and easily get to her feet. To do this, the freestall must account for the cow's normal desire to rest facing slightly uphill and to rise by lunging her body forward and getting up hind end first. The space required for a 1300-1500 pound cow to rise and recline naturally and rest comfortably is about 46-54" wide by 8' long. About 60-70" of length is required for the body space of the cow in a recumbent position. The base of this area should slope upward in the direction the cow lies 3-5" (4-6%).

A cow thrusts her body forward as she rises or reclines. A total length of 8' allows enough room for a cow to lunge forward and rise naturally. (Figure 1) Stalls shorter than 8' need an opening towards the front of the stall for the cow to thrust her head through as she rises. A 24-inch-high unobstructed opening the entire width of the stall front is very satisfactory. Open stall fronts are also important for ventilation. A brisket board 8-10" high placed at a 60-70 degree angle from the horizontal helps define body space and prevents a resting cow from moving too far front in the stall (Figure 2). If front lunging is not possible, modify the stall partition to allow the cow to lunge to the side through the partition. An area approximately 24" square is needed at the lower front sides of the stall. This may be accomplished by bending the lower rail of the partition up, as in the European (Michigan) design, or lowering the front of the bottom rail as in a wide bend type stall (Figure 3). A brisket board is normally not used in a stall with a European type partition since it may obstruct the lunge space.

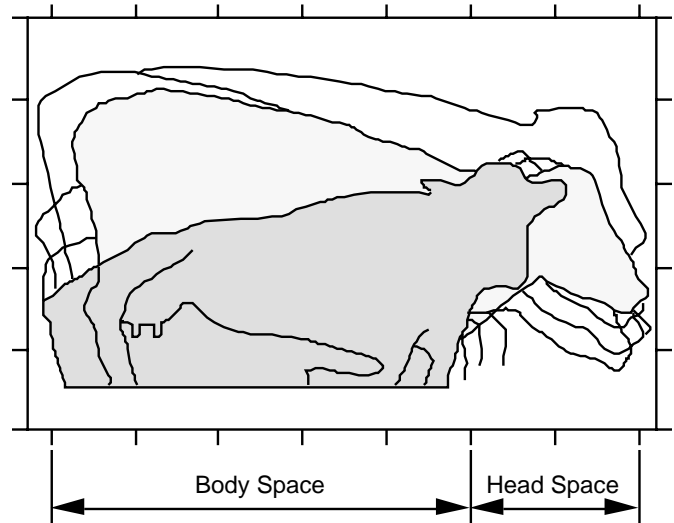


Figure 1. Space envelope for rising Holstein cows. (Irish & Merrill, 1986)

Construction and attachment of stall components must be rugged and long-lasting with minimal chance for pinch points or other injury. There are many variations in partition size, construction material, stall base, and bedding. Regardless of shapes, sizes, or materials, the most crucial requirements continue to be the comfort and cleanliness of the cow.

The primary components of a freestall are:

- Freestall partitions
- Base or stall bed
- Bedding layer
- Brisket board
- Training or neck rail
- Curb

Proper dimensions are critical to the performance of a freestall. For uniformity, most stall dimensions are taken from the top rearmost point of the freestall alley curb. Important dimensions of a freestall are:

- Stall length
- Stall width
- Stall base slope
- Partition length
- Partition height and clearance
- Rear curb height
- Brisket board placement height and angle
- Training or neck rail placement

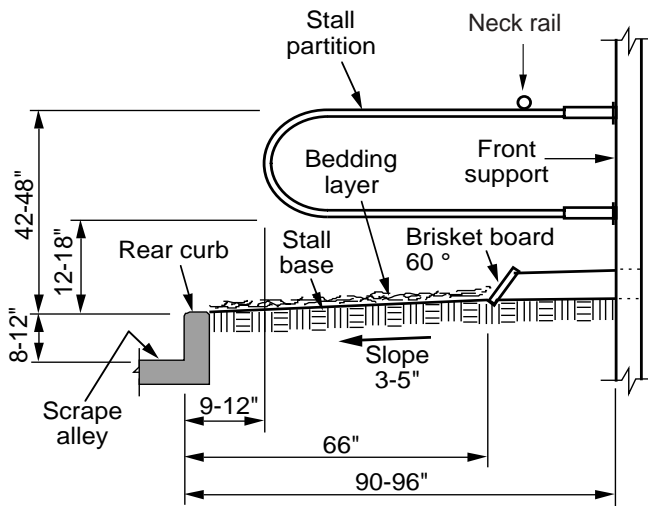


Figure 2. Freestall components and dimensions.

Freestall partitions should guide the cow into and out of the stall, help position the cow, and provide “protection” from cows in adjacent stalls. A variety of partition designs are in use. Modern stall partitions are suspended from the front of the stall instead of having a post embedded at the rear curb. Special designs for use in short stalls accommodate the need for the cow to stick her head through the front side when she lunges forward. Cow comfort and safety are of prime importance in the design, installation and management of freestalls.

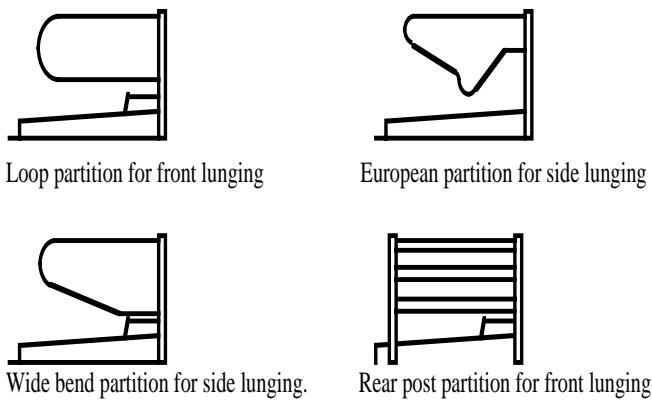


Figure 3. Typical freestall partitions.

A simple suspended wooden freestall divider (Figure 4) can be constructed using heavy posts and 12" hardwood planks. These dividers mimic typical suspended loop dividers. Stall base construction and maintenance are critical to the successful use of these partitions. Because they occupy less vertical space, they will not confine the cow as completely as other designs. Excessive space below the divider may encourage some cows to lay in the stall at an angle, with head and shoulders under the partition. Low spots

or holes in stall beds increases this problem. Mounting the divider too low will make it easier for cows to turn around in the stall extending their bodies over the partitions while turning. Also, the resulting lower neck rail may interfere with cow movement and increase stall refusal. Making adjustments or modifications to these stalls after they are installed is difficult.

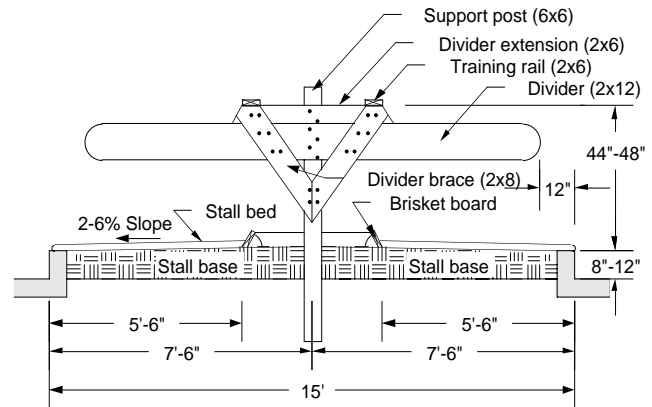


Figure 4. Wooden freestall divider.

The freestall base and bedding should provide a comfortable conforming surface to cushion the cow as she drops to a resting position and while resting. To be comfortable, the base and bedding layers should cushion areas where knees, hips, brisket, and shoulders protrude. Provide cushioning by a thick layer (3 to 6") of bedding on a firm base or by an intermediate cushioning layer. Typical cushioning layers are mattresses or soft rubber mats. Mattresses are made by covering an organic material, such as straw or sawdust or inorganic materials such as crumb rubber, with a woven polyethylene or felt-type geotextile material. Mattresses may be draped over the material (Figure 6) allowing easy removal or addition of bedding material or wrapped around the material (Figure 7). Hard rubber mats provide little cushioning and may be slippery. Soft rubber mats provide some of the same features as mattresses. Bedding is required on top of mattresses and mats to help maintain clean/dry conditions.

In addition to preventing injury and providing comfort for cows, freestall bases that require minimum maintenance are desirable. Materials used for bases vary from stone-free earth fill, available on the site, to concrete. Earth fill requires the most maintenance as cows getting up and down will disturb and hollow out the surface. Select a material which does not contain stones that can be kicked into alleys causing injury to cows' hoofs. Harder surfaces, such as concrete and hard rubber mats, do not hollow out but are less

comfortable, can increase the chance of injuries and lead to stall refusal. Common base materials include:

- Hard packed earth
- Earth and tires
- Concrete and tires
- Wooden planks
- Concrete
- Mattresses (filled with organic material, or shredded rubber)
- Hard and soft rubber mats

Regardless of base material, a layer of bedding material is needed to provide additional cushion, absorb moisture, help keep the cows clean, and restrict bacterial growth. Low cost and ease of handling are desirable. Mixtures of different bedding materials are often used. Effect of bedding on manure handling systems should also be considered. Various organic and inorganic materials are used for bedding such as:

**Organic materials:**

- sawdust
- straw
- hay
- shavings
- cornstalks
- peanut hulls
- chopped or shredded paper
- recycled manure solids

**Inorganic materials:**

- sand
- limestone screenings

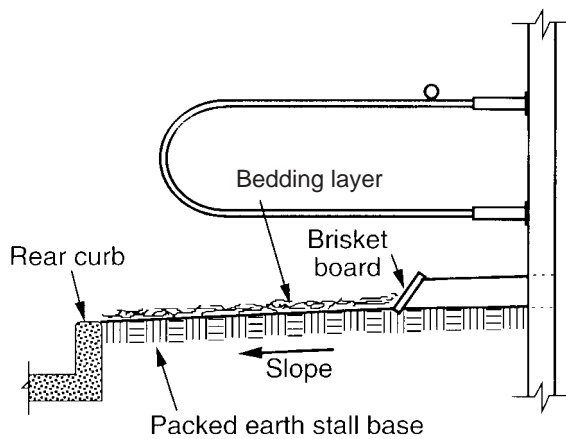


Figure 5. Freestall with packed earth stall base.

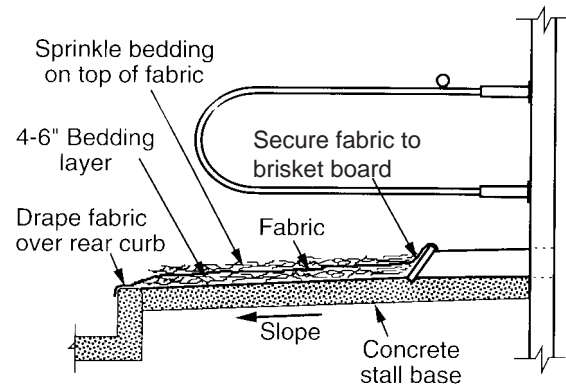


Figure 6. Freestall with draped mattress stall base.

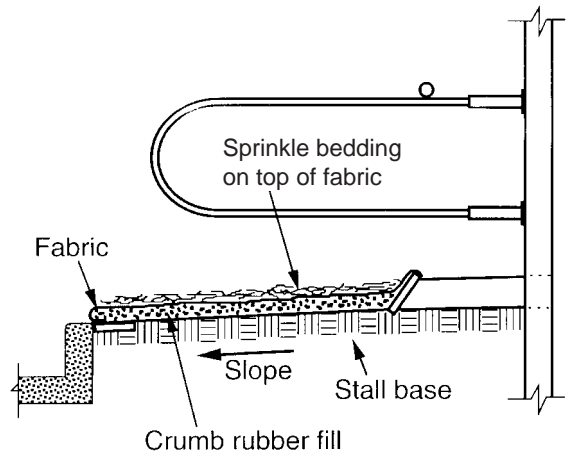


Figure 7. Freestall with shredded rubber-filled mattress.

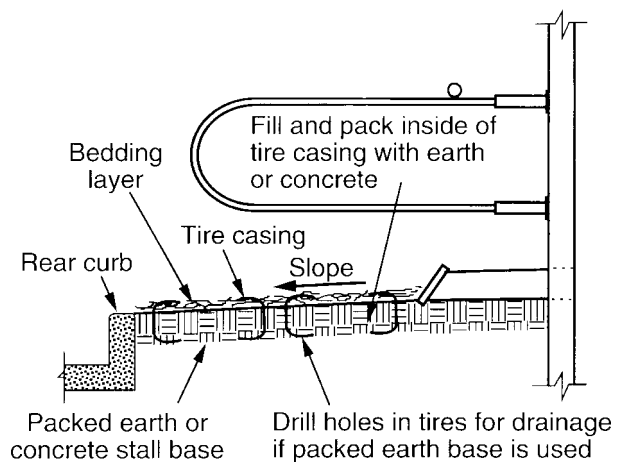


Figure 8. Freestall with earth or concrete and tire stall base.

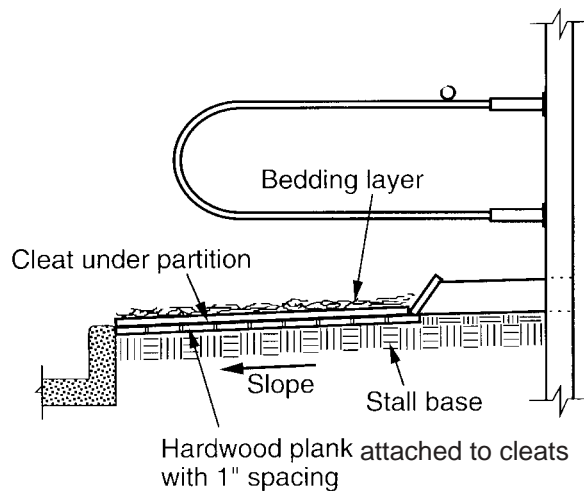


Figure 9. Freestall with wood plank stall base.

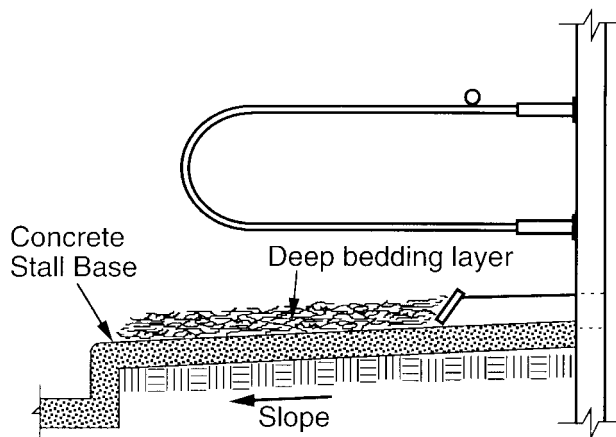


Figure 10. Freestall with concrete stall base. Requires a deep bedding layer.

## Management and Maintenance of Freestalls

Regardless of stall design, partition selection, base material or bedding, regular management and maintenance of freestalls is required to assure clean comfortable cows. Cow cleanliness is the first step in efficient effective milking routines and quality milk production. Check stalls at least twice daily, remove deposits of manure or urine and rearrange bedding to assure a clean uniform resting surface. This task is normally done while moving cows to the milking center or as part of cow observation. Periodic addition of bedding and/or base material is also required. Bent or broken parts should be repaired before they become a serious obstacle to cow comfort or use of the stalls.

## Additional Material on Freestall Housing

G-72 Dairy Manure Handling

G-75 Natural Ventilation for Freestall Barns

H-72 Site Evaluation for Dairy Housing Systems

The above fact sheets are available from: Agricultural and Biological Engineering Extension, 246 Agricultural Engineering, University Park, PA 16802, (814) 865-7685.

NRAES-24 Dairy Free Stall Housing

NRAES-26 Milking Systems and Milking Management

NRAES-31 Dairy Manure Management

NRAES-38 Dairy Feeding Systems Proceedings

NRAES-63 Dairy Reference Manual

NRAES-66 Milking Center Design

NRAES-77 Expansion Strategies for Dairy Farms

NRAES-79 Liquid Manure Application Systems

NRAES-85 Penn State Freestall and Heifer Housing Plans

MWPS-7 Dairy Freestall Housing and Equipment

For a complete list and prices of NRAES and MWPS publications write to: Publications Distribution Center, 112 Agricultural Administration Bldg., University Park, PA 16802

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