

LAYOUTS AND COMPONENTS FOR MODERN MILKING CENTER

Robert E. Graves*
Member ASAE

Douglas J. Reinemann*
Member ASAE

ABSTRACT

This paper describes the function and relationship of the major components of a milking center for a modern dairy farm. Steps to consider in planning a milking center and the importance of allowing for expansion and modification are covered. Safety and comfort of workers and animals are also highlighted.

KEYWORDS. Animal care, Dairy, Milking parlors, Safety, Workplace design

INTRODUCTION

A milking center is a specialized building, or section of a building, designed to milk cows and handle milk on a dairy farm. The milking center must be designed, constructed, and managed with the goal of providing an excellent environment for the cow and worker. The milking system and its operation must assure continuous production and storage of high quality milk. Cows are brought to the milking center, milked, and then returned to their feeding and resting area. The milk is collected, cooled, and stored. Milk handling and storage equipment must also be washed, sanitized and stored in an appropriate manner. A well-designed milking center allows the animals, milk, and wastewater to be handled effectively and efficiently. Most of the dairy income (milk) and income producers (milking cows) pass through the milking center everyday. The milking center may also be the focus of other activities on a dairy farm. Often, it is the first place visitors stop, and may be the location of telephone, office, rest rooms and various other facilities. Design and construction of the milking center must consider these possible uses. Location and layout of the milking center and entrance doors can encourage or discourage its use for non-milking activities.

COMPONENTS OF A MILKING CENTER

At a minimum, a milking center must provide the following features:

- Holding area—a pen for short-term holding of cows to be milked.
- Milking parlor—the area where cows are milked.
- Milk room—a room for milk cooling and storage. It also has wash facilities for cleanup and sanitation of milking equipment.
- Utility area—room or area that houses the mechanical equipment necessary for milking and cooling of milk such as vacuum pumps, refrigeration compressors, and hot water heaters.

* R. E. Graves, Professor of Agricultural Engineering at Penn State University, University Park, PA 16802-1909.
D. J. Reinemann, Assistant Professor of Agricultural Engineering at The University of Wisconsin-Madison, Madison, WI 53706.

- Supply area—a store room or cabinets for chemicals, paper towels, milk filters, and other supplies necessary for the milking operation.
- Medicine area—appropriate labeled and secured cabinets, refrigerator or room for medications that may be required during the milking operation.

In most cases, milking centers also include some or all of the following:

- Office—for record keeping and herd record storage. In some cases, office facilities for the entire farm operation are maintained at the milking center.
- Worker Comfort Areas—items such as lockers, shower, toilet, wash basins, kitchen, lunch table, and lounge area.
- General Storage—for storage of parlor and milkroom supplies, as well as tools and repair parts for milking center equipment. This area may also include a work bench or repair area for milking center-related repairs.
- Drug Storage—an area or room for storage of drugs necessary for use with lactating and nonlactating animals. Requires provisions for separation and labeling of lactating and nonlactating drugs and appropriate security and temperature.
- Separation/Treatment Area—an area or room where cows are held for short time periods (1-2 hours) for examination or treatment, such as breeding. Cows requiring special or long-term care may be moved to another location.
- Hospital Area—an area for long-term isolation and convalescence of cows that can not be kept with the milking herd. This area must include feed and watering facilities and provide for clean, comfortable resting.
- Maternity and Springing Cow Area—a housing area for cows ready for calving and a clean, isolated area for calving. It is often located at or near the milking center to allow easy observation. The hospital area is not a suitable calving facility.
- Calf Ration Preparation—an area or room with hot and cold water for mixing calf rations.
- Animal Loading Facilities—a ramp or dock for loading and unloading animal trucks or trailers.
- Wash/Drip Pens—areas where the underside of a group of cows may be washed with floor mounted sprinklers and then allowed to drip dry before entering the holding area and milking parlor.

DESIGN

A milking center is the most complex building on the dairy farm. At a minimum it must provide for the handling of cows, workers, milk, vacuum, hot and cold water, wastewater, manure, chemicals and other supplies, and ventilation air. In addition, there may be collection tanks and pipes for recycled water, moderate or high-pressure wash water lines, warm water lines with or without additives, high pressure air lines, nonsalable milk lines and storage, sanitary sewer lines, offices, worker comfort areas, and public observation areas.

The cow and the worker are the most important components in the design and selection of a milking center and its parts. Designs which plan for the comfort and well-being of both the cow and the operator result in the best long-term productive arrangement. Animal traffic patterns, parlor hardware, gates, slippery floors or anything else that causes cow discomfort will likely result in poor milk production. Likewise, built-in obstacles or inconveniences will cause operator frustration and a decline in milking quality and effectiveness.

Layouts that require animals, vehicles and people to regularly occupy the same place or cross paths should be avoided. Minor things like floor plans that use a milkroom for the main entrance to the milking center will cause continuous problems from dirt and extraneous materials that are inadvertently left behind in the milkroom by people who have no need to be there except to get someplace else!

MILKING PARLORS

The major component around which a milking center is planned is the milking parlor. A milking parlor is the special area where cows are brought to be milked and then returned to their housing facility. Each stall or cow standing position may have its own milking unit or may share one with a nearby stall. In most cases, the milking unit will be permanently attached to the milk line. A good milking parlor will encourage an organized work routine or assembly line type milking procedure. The amount of time cows spend in the parlor or waiting to get into the parlor should be minimized. One hour or less is considered ideal.

Milking parlors are classified by the position the cows stand in relation to each other and in relation to the milker. The most basic distinction is whether the cows are elevated above the person doing the milking (flat parlor versus elevated parlor).

In elevated parlors, cows may stand in line with one side facing the operator (side opening, tandem), at an angle to the operator (herringbone), or side by side facing away from the operator (parallel). The cow's position affects the amount of the cow visible to the operator and whether the milker unit is attached from the side or between the rear legs.

Parlors are further classified based on how the cows enter and leave the area where they will actually be milked. Cows enter and leave side opening stalls one at a time. In a herringbone or parallel parlor, groups of cows enter the parlor in single file. Cows may exit in a single file through the end of a herringbone or parallel parlor, or as a group from a rapid exit herringbone or parallel parlor. In parallel parlors, cows may also reverse direction and exit single file through the same end of the parlor they entered from.

MILKING PARLOR/HOLDING AREA SPACES

The following terms and illustrations represent the major areas within the milking parlor and holding area portions of a milking center. The space occupied by these areas must be known before final design or construction of a milking center.

Cow Platform (CP) - Area occupied by standing cows and parlor framework during milking. The rear side of the cow platform is considered the operator area curb and front side is the line of mounting posts or wall required by the parlor framework (In some rapid exit designs the cows' heads may extend beyond the mounting posts). For herringbone parlors, the cow platform includes the triangular areas outside the entry and exit gates necessary to form a rectangle.

Exit Area (X) - Area required for cows leaving the cow platform area. This includes the cross over lane in a single return lane parlor.

Entrance Area (E) - Area required for cows entering cow platform area from holding pen. If a wall is placed between the holding area and milking parlor, space required for the wall should be included in the entrance area dimensions.

Entrance Funnel Area (F) - Transition area that directs cows from holding pen to cow platform. This includes area required for loading lanes and free swinging gates used in some parlors in an effort to improve cow flow.

Operator Area (O) - Depressed area where operators stand and move about during milking process.

Operator Access Area (OA) - Ramp or steps leading from operator area in milking parlor to holding pen.

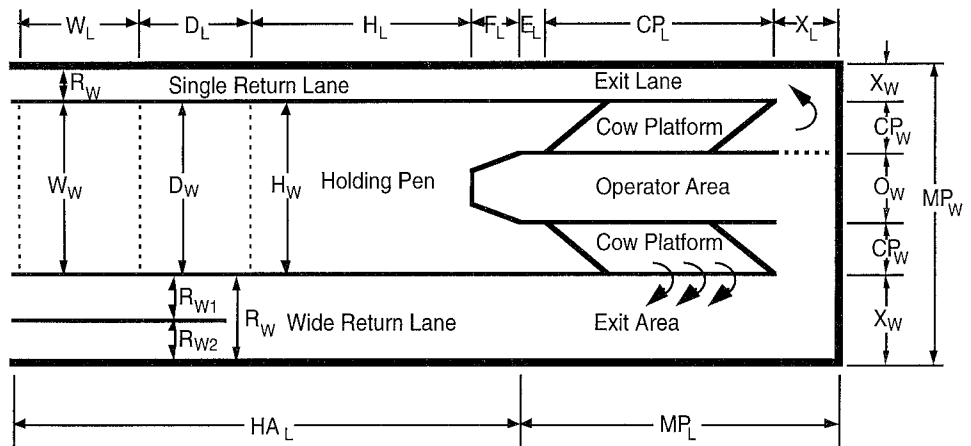
Holding Pen (HP) - Area required for confining cows prior to their entrance into the milking parlor. The holding pen is located in the holding area building.

Drip Pen (DP) - Area required for cows while they dry off following washing in the wash pen. This may be part of holding pen, separate, but in holding area building or in a separate building or area.

Wash Pen (WP) - Area required for washing cows' udders with floor mounted sprinklers. This may be part of holding pen, separate, but in holding area building or in a separate building or area.

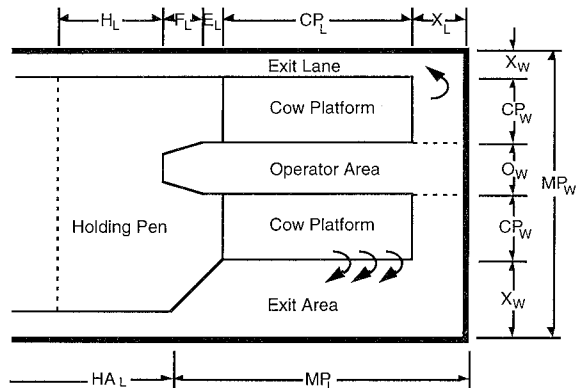
Return Lane (R) - Area required for cows leaving the milking parlor and passing through the holding area building. Lanes may be single file, multiple single file, holding lanes or wide lanes allowing side by side animal movement and tractor access.

Following are illustrations of major areas within the milking parlor and holding area.



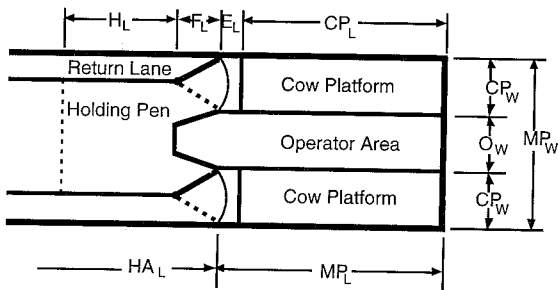
Herringbone milking parlor (standard and rapid exit)

- Holding pen, drip pen and wash pen
- Single, wide and multiple return lanes

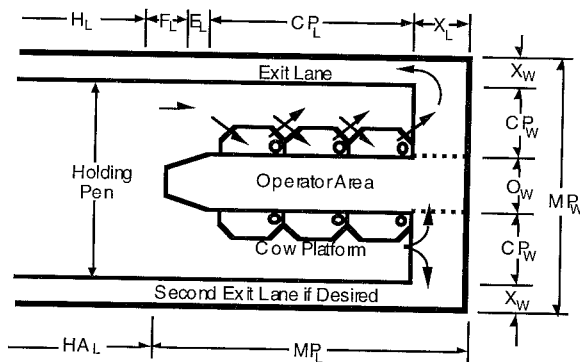


Parallel milking parlor (standard and rapid exit)

- Expanded width holding pen



Parallel milking parlor
- Entrance and exit from holding pen end



Side opening milking parlor
- One or two return lanes

PLANNING A MILKING CENTER

Planning and construction of a successful milking center requires many steps and involves many people. Many problems and complaints with milking centers can be traced to poor planning and design. An important first step is to assemble a design team and a plan of attack. A typical design team may include: key farm people (spouse, herdsman, milkers), veterinarian, design consultant, equipment suppliers, builder, accountant, financial advisor, and others familiar with the farm or with milking center design, construction, and operation. The cow also needs to be represented on the design team. At critical points in the decision-making process, the design needs to be evaluated with the cow's interest and welfare in mind.

A filing system, notebook or even just a box should be established to allow easy filing and retrieval of ideas, literature, pictures, and notes. Both good ideas to be included and things that are not desired should be recorded. Visits to other farms with parlors are an important part of the planning process. Have a "farm visit kit" with clean rubber boots, a tape measure, notebook, and either a still or video camera for field trips to other farms. A pictorial record is a convenient method of recording good and bad ideas. Keep a record of names, addresses, and phone numbers of people and farms visited on field trips. Visit farms during the various stages of milking. Talk with users not just salespeople or nonworking owners. If possible, get into the parlor and milk for a period of time. All key people who will be involved in day-to-day use of the parlor should be encouraged to visit and report on various milking parlors. Don't just visit brand new parlors. Also, visit parlors that have been in use for several years and observe how various equipment, building components and wall surfaces last under day-to-day use.

A project can be divided into five general stages:

- Study—The needs, requirements, and available resources are clarified and become the foundation for the remaining design.
- Preliminary design—Initial drawings and final design criteria are developed. Floor plans and building cross-sections are used to show building layout, building configurations, parlor size and arrangement, waste removal, etc. without specific details.
- Final design—Final drawings and specifications which describe the facility are prepared. Plans are submitted to regulatory officials for review. Final changes are made.
- Bidding or negotiating—A contractor is secured by competitive bidding or negotiation.
- Construction—The milking center is built. Discuss any changes with the contractor and agree on price before proceeding. Put changes in writing to avoid arguments later.

SIZE AND TYPE OF PARLOR

A central step in the design of a milking center is selection of the type and size of milking parlor. The following items must be addressed as part of the selection process:

- Personal desires of dairy operator
- Labor availability
- Present and Future Herd Size
- Size of groups within herd
- Milking time

Total milking time

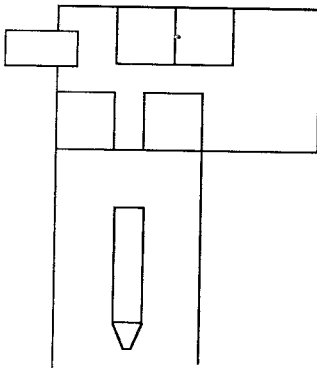
Maximum length any animal will be in the holding area

Two-time or Three-time a day milking

- Dollars available

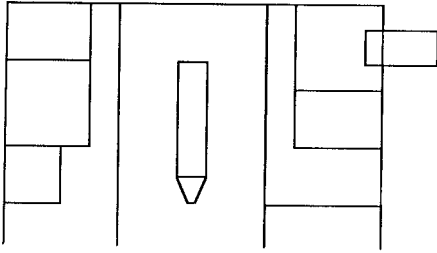
FLOOR PLANS

Most milking center floor plans fit one of the following five basic arrangements.



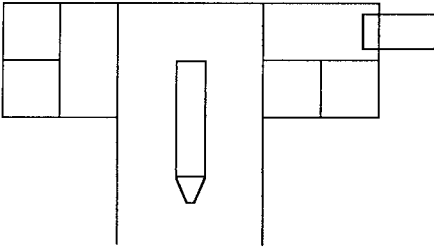
L Arrangement

- unobstructed parlor and holding area
sidewalls for natural cross
ventilation and lighting
- milkroom and other support areas
block easy expansion of parlor
- placing support wing to side will
make expansion of parlor easier but
will block natural ventilation



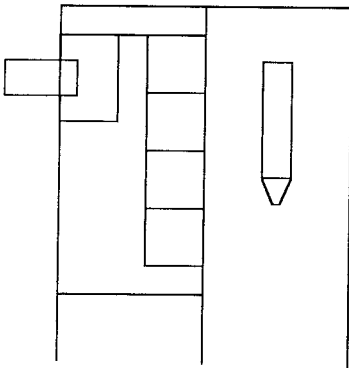
Interior Parlor Arrangement

- open end of parlor allows easy expansion, outside view from operator area and direct outside access
- parlor sidewalls are blocked by support areas preventing good natural ventilation
- parlor surrounded by warm areas, allows use of uninsulated glazed block



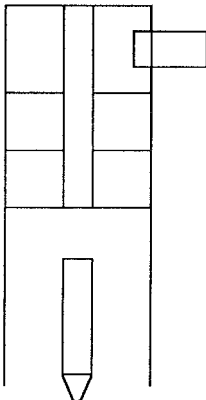
T Arrangement

- open end of parlor allows easy expansion, outside view from operator area and direct outside access
- major portion of parlor sidewalls are blocked by support areas preventing good natural ventilation
- holding area has unobstructed sidewalls for natural ventilation



Side by Side Arrangement

- open end of parlor allows easy expansion, outside view from operator area and direct outside access
- parlor and holding area sidewalls blocked by support areas, preventing good natural ventilation
- wide, short building footprint



Linear Arrangement

- unobstructed parlor and holding area sidewall for natural cross ventilation and lighting
- milkroom and other support areas block easy expansion of parlor
- lower building height provides less ventilation obstruction to buildings
- long, narrow building footprint

Any floor plan should be evaluated based on traffic patterns, modification to allow minor or major expansions, access to existing and future housing facilities, worker and animal safety, health and comfort. Points to consider include:

- Are critical areas, such as the milkroom, office or parlor also used as "hallways" for regular access to other areas?
- Will noise, heat, dirt, or oil fumes from equipment areas interfere with worker or animal comfort or milk quality?
- Are there safe, secure storage areas for drugs, and chemicals, including bulk chemical dispensers?
- Can animal workers get to needed records and supplies without having to go through "clean" areas of offices or other portions of milking center?
- Flow of supplies from delivery, to storage to final use.
- Worker traffic to and from animal area without disrupting animal flow in return lane(s).

PLANNING FOR EXPANSION

Milking center location and design should consider access from future cow housing and how the throughput capabilities of the parlor can be increased.

Parlor throughput can be increased by:

- Adding more equipment such as:
 - milker units
 - automatic detachers
 - crowd gate
 - power operated gates
- Adding more stalls by:
 - using extra space already reserved in milking parlor area
 - extending parlor through exposed end wall and increasing building size
 - extending parlor into holding area (Provisions must be available to enlarge the holding area to make up for lost space.)
 - extending parlor into another room in milking center. (Provisions must be made for relocating activities that were carried out in that room).
 - alternative parlor location in the milking center.

BUILDING REQUIREMENTS

Once the requirements for the components of the milking center are determined, it is necessary to select the size and type of construction for the building shell and its interior components. Different portions of this building may require specialized surfaces for cleanability, high levels of insulation to reduce heat loss, protection from high moisture levels, ventilation for animal heat and moisture, heating for operator comfort, fire protection, noise control, illumination, etc. Often many types of building techniques and construction materials will be used in the milking center complex. An understanding of the requirements placed on the various sections of the milking center will result in better selection and construction of the building and its components. Areas that will receive regular use, frequent washdown or heavy cow traffic require special attention to material selection, construction methods, and maintenance.

SITE SELECTION AND LAYOUT

Site selection and layout must consider the many activities that take place in the milking center and the interaction the milking center must have with other parts of the farmstead. Coordinating a new milking center with existing animal housing can be a challenge. Plans should include possible expansion of the milking center or animal housing area and addition of extra features, such as hospital and maternity areas.

Most milking parlors can accommodate many more cows than are present on the farm when they are built. Therefore, prudent planning assures that there is good access between the milking center and future building sites for cow housing. Worrying too much about use of existing buildings and ignoring potential future expansion is often a costly mistake.

Convenient flow of animals between housing areas and the milking center is essential. Locating the milking center close to animal housing areas will minimize travel time of animals and workers. However, care must be taken to minimize interference between the housing area and milking center. Two common problems are buildings that block winds necessary for natural ventilation and interference between animal traffic and feeding or manure cleaning activities. In cold climates, plans must also consider blowing snow and space necessary for snow removal and snow storage. As more cows are handled and there are more workers around, interference between different activities becomes more acute.

Topography of the site affects grading for the buildings and control of clean runoff water and wastewater. Plans that include flushing to remove manure from the holding area, animal traffic lanes, and animal housing provide additional challenges. Access to the buildings for milk pickup trucks, loading and unloading animals, feed delivery, and fire protection must all be considered. Adequate water, electricity, and other utilities must also be available.

Prevailing winds, property lines, right of ways, and location of houses must also be evaluated. These are important for ventilation, odor control, and in some cases, legal setback requirements.

ANIMAL WELFARE AND COMFORT

The modern high-producing dairy cow is a hard worker. Her welfare and comfort are vital to promoting continuous high levels of productivity. Items that lead to undue stress or injury must be avoided. Slippery floors, hot stuffy holding areas, noise, extended periods away from water and feed, equipment with pinch points or other obstructions, and faulty milking systems are a few of the obvious things to avoid. Situations that lead to worker discomfort and frustration will also have a negative impact on cow comfort.

WORKER SAFETY AND COMFORT

Worker safety and comfort is always important. As milking periods increase and workers are expected to keep track of more cows and more equipment, comfort is quickly translated into attitude and effectiveness. Items that are an annoyance, such as doors that stick, gates that interfere with cow traffic, insufficient illumination, or irritating noise, become increasingly annoying with longer work periods. Reducing or eliminating items that reduce worker safety or attitude is an important goal to bear in mind when designing or maintaining a milking parlor.

EXISTING BUILDINGS

Existing buildings often affect the design and location of a milking center. This may be coordinating the milking center with existing cow housing facilities or it may be trying to use an existing building to house some or all of the milking center. Building a milking center in or around an existing building is fraught with problems. There is a tendency to overestimate the value of an existing building and underestimate the cost of remodeling it into a milking center. Costs will involve not only problems during construction, but increased maintenance problems and negative effects on day-to-day operation. Compromises that affect items such as cow flow, ventilation, and worker access will be a continuous cost. Approach reuse of an existing building with extreme caution and skepticism.

Older, well-designed and constructed parlors can often be improved by careful selection of new equipment or other technology. Any modifications must be critically evaluated as to their ability to provide improvement in working conditions and productivity and to provide an adequate return on investment.

SUMMARY

Milking center design is one of the largest, most complex and critical building decisions made on a modern dairy. A very high percentage of the income of the dairy is dependent on continuous excellent performance of the milking center. However, a costly milking center with too few cows will have a negative impact on profitability. To achieve optimal performance, primary considerations must be given to the welfare and safety of the workers and the cows. The successful dairy manager will take advantage of many sources of information and assemble a design team to assure an excellently functioning, modern milking center. The most common mistake in milking center design and construction is inadequate planning.