

# Remodeled Parlors

by

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Developing a remodeled parlor can be an exciting process. It can also become complicated and sometimes overwhelming, but it can be done by following the process step by step. Determining your likes and dislikes is the most important part of the process and will affect whether the resulting facility is something you love, or tolerate, or hate. The first step is to develop a list of business and personal goals. Use this list as a guide and follow it during the design process. When decisions need to be made, use this list to help decide if a particular decision accomplishes the goals listed.

## Setting Goals

Most families have specific personal and business goals they are trying to achieve with the decision to remodel a parlor and change the way they milk cows. Here are some common goals offered by farms that went through the planning and design process:

- Improved health of back, knees, and hips
- Improved labor efficiency
- Improved quality of life
- Improved milker safety
- Improved profitability

## Background

People use a variety of terms to describe the idea of building a low cost parlor. “New Zealand” parlor, “swing” parlor, and “low cost” parlor are terms that have been used in the popular press to describe what has been implemented on many farms. These terms are not very accurate in describing what is possible in planning, designing, and constructing a remodeled parlor.

The term “New Zealand” parlor is a good example. New Zealand has all kinds of parlors, including herringbones, parallels, and rotaries. The “New Zealand” parlor term commonly used by the media describes a parlor where the cows stand in a herringbone arrangement with a parking angle of around 70 degrees. The milking system uses a high or mid-high milk line over the operator area with one milking unit shared between two stalls. The milking unit is swung from one side of the parlor to the other and is attached to the udder from the rear. The

“New Zealand “ parlor also describes a parlor that has a simple stall design, with the cows standing between a breast rail and a kick rail.

Even the term “low cost” has some negative connotation. To some it may mean “cheap”. To others building a “low cost” parlor is a major goal of the farm and the achievement of that goal has allowed the farm to continue in the dairy industry. In many cases an existing structure such as the stanchion/tie stall barn is remodeled into a parlor to save the costs of a new shell and milkhouse.

### **Budgeting for the Parlor**

Farmers have to decide for themselves how much they are willing to budget for construction of a parlor. One rule of thumb is to spend no more than 20% of the gross annual milk sales on the parlor. For example a dairy farm producing \$240,000 of milk per year could spend \$48,000 for the parlor. A ball park cost for a new turnkey swing 12 parlor is \$6,000 per milking stall. The ball park cost to remodel an existing stall barn into a swing 12 parlor not including a milkhouse is \$2,000-\$3,000 per milking stall. It is common to hear from farms that have remodeled a parlor costs that range from \$20,000-\$100,000 for double 6-12 parlors. Potential savings of 20-30% have been realized by farms that designed a swing line milking system in a remodeled parlor. They used some of their own equipment, bought used equipment, and traded equipment with the dealer.

### **Keeping the Cost Low**

There is ample opportunity to manage the cost of the parlor. However, with a limited amount of resources(money), decisions will have to be made on what to spend money on now and what to wait to buy. Developing a good cost estimate will also allow an informed decision process to take place. Obtaining competitive bids on appropriate parts of the project will give a realistic cost of a project. The point in determining a budget estimate is to critically determine what you need and want, and to determine the minimum cost of achieving the design.

The following is a list of suggestions to keep the cost of a parlor to a minimum.

- Keep the parlor layout and stall design simple.
- Provide sweat equity for demolition and construction (use your own labor or labor from friends, family, neighbors).
- Recycle used or existing equipment in the new design.
- Buy used equipment from a dealer or at an auction.
- Remodel an existing building shell.
- Use the existing milk house.
- Reduce the amount of equipment required in the parlor design.
- Choose the basic line of equipment versus the high end line of equipment.
- Prioritize the budget to help the decision process.

Budget for required items first and add options at a later time when cash flow allows. Stay within the budget set.

These are not new ideas. Many projects use several of these methods to keep the cost within budget. The opportunity for dairies in a transition from the stall barn system to a parlor free stall system is that there may be time available at this stage of the business to provide sweat equity without hurting the dairy operation. Use your talents or the talents of your family members, friends, and neighbors willing to help. Some dairy farm neighbors have even set up parlor raising groups to help each other build their parlors similar to barn raising activity of the past.

Take advantage of opportunities when they present themselves. Auctions, and sales may have the equipment you need or can adapt to your design. Going through a planning exercise and having a plan in mind will allow you to make informed decisions when opportunities arise. Many milking equipment dealers have worked on remodeled parlors and can offer design assistance if the right questions are asked. You have to be clear on what your goals are and explain that to the contractors involved.

## **Siting**

The milking center should be as close as possible to the housing area. However in the transition, the new site for the cow housing (and new parlor someday) may be a distance away from the stall barn. It is reasonable to walk cows some distance between the free stall barn to the remodeled parlor. Farms have walked cows over 800 feet from the new free stall barn (and someday the new parlor) to the remodeled parlor for several years during the transition. Compromising on the future site of the new dairy may affect other design issues like the free stall barn, manure storage, and feed storage siting. Using the stanchion/tie stall barn as a remodeled milking center can fit in very nicely in the transition.

## **Remodeling Planning and Design**

The milking center should be designed for both the cow and the person milking. It should serve the function of milking efficiently with a good environment for the cow and the operator. The design should also be as flexible as possible and allow for future adoption of new technological changes.

There are a variety of buildings such as machine sheds, hog barns, and dairy stall barns that have been used to remodel into a parlor. A building that is structurally sound and at the proper site is a good candidate for remodeling. There are a variety of ways to remodel the building into a parlor. The choice of the milking stall design and milking system will influence the cost and difficulty of the project. The resources of an individual farm can vary significantly. One farm may have a good structure to work with, while another has extra labor available. The challenge is to make the best use of the resources available to meet the goal of developing the parlor while keeping the cost within the budget.

Remodeling requires good planning, design, and sometimes creative solutions to problems posed by the existing facility. People can be very creative when posed with their own set of unique resources. However, there are some basic principles that should not compromise the parlor design. Adequate space and good cow flow are examples. Other design principles can be adapted to the existing situation. Stall design, and milking system options are examples. However, the resulting design should be functional and meet the goals set down in the beginning of the process.

Good planning won't eliminate all mistakes but it should reduce the number and severity of mistakes that inevitably show up in any project. Remodeling projects almost always encounter unforeseen conditions or surprises that can change the planned project in some way. Understanding that this can happen should allow the project to proceed by adapting the design to meet the conditions found.

### **Space and Functional Design**

In many cases the existing stall barn is in reasonable shape to continue to be used in the dairy operation. It is also reasonable to use the stall barn as a milking center since the milkhouse is adjacent to the barn and can continue to be used in the remodeled parlor plan. The milk house is a valuable resource that can significantly decrease the cost of the project if it does not have to be rebuilt. The parlor space should be placed as close as practical to the existing milkhouse to reduce the distance milk must be pumped from the receiver to the milk bulk tank. Additional bulk tank space can be added by bulk heading into one of the milk house walls. It is very important to consider cow flow into the holding area and parlor. If good cow flow requires the parlor to be placed further away from the milk house it is probably a better decision to pump the milk a little further compared to poor cow flow.

When space for the parlor and holding area are laid out in the existing stall barn, there is usually very little space left for housing and feeding cows. Also, there may be more appropriate use for the remaining space such as a catch pen or treatment area. In general, it is best to maintain a single use for the remodeled space. Trying to continue to house and feed part of the milking herd or the dry cows in the extra stalls in the barn may not be a good use of the space. It is usually too labor intensive and can create other problems for either use such as poor ventilation of the housing or poor cow flow into and out of the parlor. Using the existing stall barn as the milking center usually requires new cow housing somewhere else usually in a free stall barn that creates a better environment for the cow and is more labor efficient.

### **Construction Process and Relationships**

In many cases the farmer will act as the general contractor hiring other contractors for carpentry, concrete, equipment, and milking system work. Acting as the general contractor can save money but it does require time to oversee construction, manage the contractors and deal with conflicts. As a dairy farmer acting as the general contractor, be aware of the other side of the coin. Be

prepared to spend the necessary time to manage the project during construction. If the time is not available for you to manage the construction process, or the expertise is not available, then it is probably better to hire someone who knows what they are doing. 10-15% of the project cost is commonly charged by a general contractor for providing those services.

One advantage of a general contractor is the connections the contractor has with other sub contractors. Sub contractors are more likely to bid and work with a general contractor that they have a long standing relationship with compared to an individual farm who they may never work with again.

### **Timing the Construction**

The construction process may take between 2-3 months from start to finish. Milking during the remodeling construction project can be a stressful time for both the milker and the cows. The space to be remodeled will have to be vacated during construction. Milking can be done in part of the barn unaffected by the initial construction phase such as the future holding area. The stalls in that part of the barn can be used as a flat barn parlor and switching small groups of cows several times. The existing milk line system can be used to milk with out interfering with the space that is to be remodeled. When the new parlor and milking system is ready to be switched over, it hopefully can be done between morning and night milkings easily.

### **Structural Changes**

For the typical 32-36' wide two story barn with two rows of posts and beams there will need to be some structural changes made to widen an area large enough to place the operator area and stalls. In this situation, only one set of posts needs to be removed over the parlor length. In many cases this may be only 3-5 posts. The old beam support posts are replaced by cross beams and new posts. See Figure 1. If ceiling height is adequate, the new cross beams can be placed under the existing king beams to support them. If ceiling clearance is limited, the new cross beams can be placed above the king beam with saddles supporting the king beam.

The 20-24' width available in this layout is close to the width available from an outside wall to the opposite row of posts. A simple swing stall design with cows loading on one end and exiting the opposite end requires 20-24' of width. There are also parallel and herringbone stall designs on the market that allow exiting out the end of the parlor rather than rapid exit. The absolute minimum width that should be considered is 18 feet wide interior dimension. 20 feet wide is much better and anything over 24 feet is allows additional layout options.

During the structural changes, proper shoring and blocking should be used to support the existing structure to keep the work area safe during construction. An experienced contractor or engineer should be consulted to properly size the replacement beams and posts. This is too important a design change to allow a quick uninformed fix.

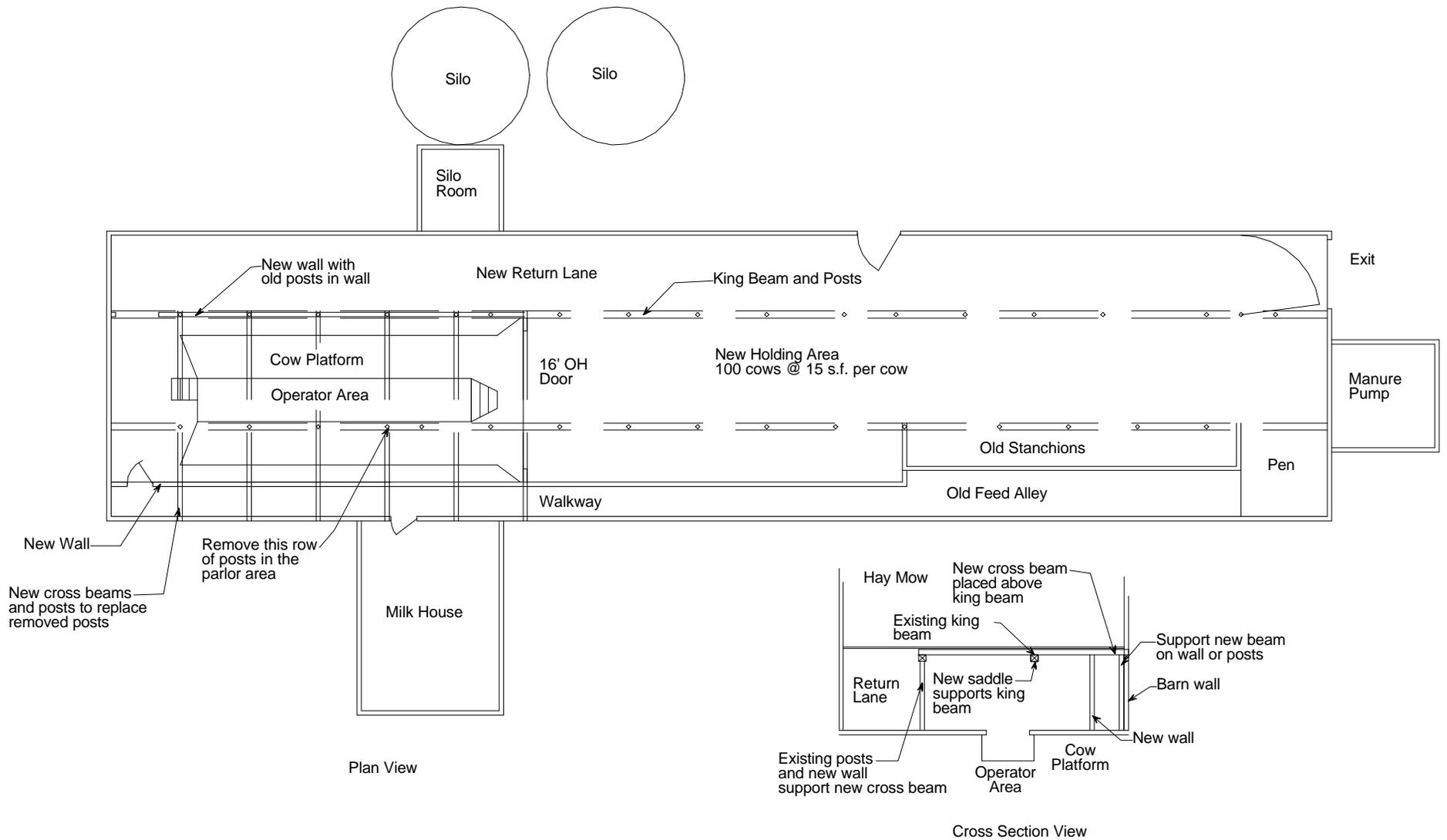


Figure 1. Two Story Stall Barn Remodel Plan

For 32-26' wide clear span stall barns it is relatively easy to accommodate almost any type of parlor stall design without major structural changes. The barn will have to be a 32-40' wide to accommodate a parallel stall with rapid exit. In this case both rows of posts may need to be removed to accommodate the required width for the stall and cow platforms. Some farms have removed the entire second floor over the parlor and framed it with clear span flat trusses to increase the width and allow easier interior finishing. This may seem to be a costly decision, but cost estimates have shown that it is a reasonable approach to make the parlor space functional.

### **Concrete Demolition**

The existing stall barn concrete floors and curbs are almost never at the correct position, slope or elevation to fit into the new parlor design. Existing concrete will almost always have to be removed to lay out the remodeled parlor walls, curbs and flat work. Although most people dread the thought of tearing out old concrete, it in fact is relatively simple task if the right equipment is used. A large barn door or wall opening and the necessary ceiling height must be available to allow access by a skid steer loader. A skid steer loader with a hydraulic jack hammer attachment can make short work of existing concrete. The skid steer loader can then be used to carry away the spoils. The skid steer loader can also be used to dig out the operator area for concrete form work to be placed. The cost to remove and replace the concrete properly can impact the functional use of the parlor for a very long time. Good design and new concrete can save time by reducing chore time for parlor and holding area clean up.

### **Milking Stall Options**

There are three basic arrangements for the parlor stall design and layout. A herringbone stall design has the cow parked at approximately 45 degrees in relation to the length of the operator area. The on center distance between udders is approximately 36-48 inches. Milking units are attached from the side. This increases the operator area and parlor length. This design is suited to a situation where the building width is limited. A parallel stall design has the cow parked at 90 degrees in relation to the length of the operator area. The on center distance between udders is approximately 27 inches. A parabone or swing stall design has the cow parked at approximately 70 degrees (almost parallel arrangement) in relation to the operator area. The on center distance between udders is approximately 27 inches. In the latter two designs the milking unit is attached to the cow between the rear legs. These designs are suited to a situation where the building length is limited. Information on building the simple swing parlor stall is found later in this paper.

In most stall designs there is a considerable amount of steel placed between, in front and in back of the cow. In the herringbone design the stall separates the cows from each other and indexes them so that the cow udders are at a specific spacing. In a parallel design the stall is designed to separate cows with sequencing gates and also place the cow's udders at a specific spacing. In

general the more steel in a specific stall design the more cost to the stall design. In addition, indexing, rapid exit, and sequencing gate options will all increase the cost of the stall.

In a parabone design the amount of steel is minimal usually a front breast rail, and rear rump and kick rails. There is minimal or no steel between the cows. This can cause the cows to bunch up or space themselves out during loading which can position the udders at a varied spacing. This is usually not a problem in parlors with up to 12 cows on a side. For larger parlors than this, indexing can be used to space the cows more uniformly along the parlor length.

When a manufactured stall is placed in the parlor, the manufacturer recommendations for placement and dimensions of stalls, posts and gates should be followed. Herringbone stalls will fit in a narrower dimension compared to a parallel stall.

### **Factors that Affect Cow Throughput**

There are several factors that can affect cow throughput performance of a parlor including: milk production level, milking routine, number of persons milking, and parlor design. For example, a high producing herd will take longer to milk than a lower producing herd. If udder preparation is minimized, milking time can be decreased, but potentially at the cost of milk quality. Predip hygiene can reduce parlor performance by 15-20% because the operator must make two additional passes by the cow. One slow milking cow in the line will decrease parlor throughput. In general swing equipment parlors and low line equipment parlors with a similar milking routine will operate at equivalent cow throughputs. If cow flow is poor because of design errors cow throughput is reduced. Remodeling compromises in exit space, pit depth and gutter or grate interference can reduce parlor performance by 25% compared to new construction without design compromises.

### **Sizing the Parlor**

The parlor should be sized to have a milking chore time of 1-1/2 to 2 hours or less per milking group including setup and cleanup. This translates into an approximate milking time of 1 to 1-1/2 hours. One way to look at cow throughput is to determine the time it takes to milk a side. A turn (cycle) is defined as the time measured from the entrance of the first cow on a side to the next time the first cow enters the same side. A well designed parlor can turn a side (cycle) in 15 minutes, or provide 4 turns (cycles) per hour (8 sides per hour). A cycle time of 12 minutes or 5 turns per hour per side (10 sides per hour) can probably be achieved with minimal udder preparation and very good cow flow. Design information suggests parlors be designed to have 3-5 turns per hour per side (6-10 sides per hour), with an average of 4 turns (8 sides) per hour. This means that the cycle time ranges from 12 to 20 minutes, with an average of 15 minutes.

To determine the parlor size assuming 4 turns per hour (8 sides per hour), take the number of cows to be milked and divide by 8 for a one hour milking time or 12 for a 1-1/2 hour milking time. This will be the number of stalls needed per side. For example for a 100 cow divided by

8 is 13 per side for a one hour milk time and 9 per side for a 1-1/2 hour milk time. Table 1 shows parlor sizes for two different herd sizes at different cycle times and milking times to help compare other assumptions.

Table 1. Parlor Sizing for Swing Parlors

			Group Size			
			50 cows		100 cows	
Turns per Hour	Sides per Hour	Cycle Time (minutes)	Milking time		Milking time	
			1 hour	1 1/2 hour	1 hour	1 1/2 hour
			Number of stalls per side <sup>1</sup>			
3	6	20	9	6	17	12
4	8	15	7	5	13	9
5	10	12	5	4	10	7

<sup>1</sup> Number of stalls per side are rounded up.

### Labor Management

To be most labor efficient, it is recommended the parlor be sized to have only one person milking. However when first starting up the parlor or when training a group of heifers, it is a good idea to have the extra person(s) there to help during this stressful time (stressful for both the milker and the cows!).

On many farms it is common to have two people working during the milking. One person typically milks cows and stays in the parlor operator area while the other moves cow groups and does other chores as necessary and convenient. It is common to hear from farmers after the remodeled parlor is running that the number of cows being milked per hour per person is almost double from what was possible in the stall barn.

### Milking System Options

High line milking systems commonly used in around the stall barn milking can be adapted to be used in a swing parlor design. The milk line is looped for easy cleaning and placed above the operator area at the appropriate height along with the vacuum line. Additional milking units can be added to match the parlor size. The number of units per slope will be dependant on the line size which is discussed later in this paper. Milking units and/or ATOs can be hung in the middle of the operator area at the proper height and shared between two stalls by swinging the unit from one side of the parlor to the other side. With this system, the hoses hang down in the middle of the parlor obstructing a clear walkway for the operator. To position the hoses toward the side of the operator area, provide a horizontal support above the operator area at each milking unit position to hang the milking unit and ATO onto. The

milking unit can then be slid from one side of the parlor to the other, positioning the hoses away from the middle and increasing the open space for walking. Some innovative farmers have built other devices to change the position of the milking unit and ATO to open up the middle of the operator area.

Low line milking systems can also be adapted to a remodeling situation. In some cases buying a used low line milking system can save money compared to buying a new high line system. Space must be made available for the receiver group and the steps into the operator area entry must be designed to allow easy access over the milk line. In this case each stall could have its own milking unit and/or ATO.

One option to reduce costs is designing the system so that milking units can be shared from side to side. The system is designed similarly to an around the barn pipeline system with ports at each stall location and the milkline is placed below the cow platform. The milking units are detached from the milkline on one side of the parlor and attached to the milkline on the other side of the parlor. The ATO can either move with the milking unit or an ATO is placed at each stall location.

The milk line position can be low or high. There are varied opinions on which milking system is best. In fact both systems can be designed to function properly and harvest quality milk with minimal impact on udder health. High line systems typically operate at slightly higher vacuum levels than low line systems. This can cause some teat end damage if over milking occurs. With proper milking procedure and management of ATOs, minimal impact on the udder health can be achieved.

To reduce the number of milking units needed to milk, milking units can be shared from side to side of the parlor, or between two cows on the same side. This is done in a mid high milkline system by swinging the milking unit from one side of the parlor to the other side of the parlor. In a low milk line system, some farms have set up the system to have ports on the low milkline and unhook the milking unit from one side of the parlor and hooking to the other side.

### **Milk Line Sizing**

One way to keep the cost of the parlor down is to use existing or used equipment as much as possible. Work at the UW Milking Research Lab has helped to establish proper milk line sizing for milking and cleaning. Table 2 and 3 shows milk line size and the number of milking units that can be used on the milk line depending on the operator. A careful operator attaches milking units while trying to minimize transient air from entering the milk line. Table 2 shows that with a 2 inch looped milk line, a swing 10 parlor (5 milking units on each slope with 2% milk line slope) could be designed.

Table 2. Milk Line Size and Number of Milking Units Used for a Careful Operator. (Transient air admission of 3.5 ft<sup>3</sup>/min. per milkline slope.)

Looped Milk Line with Milking Units Attached Simultaneously by Careful Operator					
Nominal Line Size	Milk line Slope (%)				
	0.8 %	1.0 %	1.2 %	1.5 %	2.0 %
	Maximum Number of Milking Units/Slope				
2 inch	2	3	3	4	5
2.5 inch	6	6	7	9	10
3 inch	11	13	14	16	19
4 inch	27	30	34	38	45

Note: A slope of 0.8 % is equivalent to 1" drop in 10'. A slope of 1.2 % is equivalent to 1½ drop in 10'. Milk line slopes greater than 1.6 % (2" per 10') are not recommended unless the cow platform is sloped in the same direction as the milk line. Table from ASAE S518.2 July 1996.

A typical operator may not be as careful in minimizing transient air admission. This requires less milking units to be on a specific line size and slope compared to a careful operator. Table 3 shows that the same 2 inch looped milk line would only be able to handle a swing 6 parlor (3 milking units per on each slope with 2% milk line slope).

Table 3. Milk Line Size and Number of Milking Units Used for a Typical Operator. (Transient air admission of 7 ft<sup>3</sup>/min. per milkline slope.)

Looped Milk Line with Milking Units Attached Simultaneously by Typical Operator					
Nominal Line Size	Milk line Slope (%)				
	0.8 %	1.0 %	1.2 %	1.5 %	2.0 %
	Maximum Number of Milking Units/Slope				
2 inch	1	1	2	2	3
2.5 inch	4	4	5	6	8
3 inch	9	10	12	13	16
4 inch	24	27	31	36	41

Note: A slope of 0.8 % is equivalent to 1" drop in 10'. A slope of 1.2 % is equivalent to 1½ drop in 10'. Milk line slopes greater than 1.6 % (2" per 10') are not recommended unless the cow platform is sloped in the same direction as the milk line. Table from ASAE S518.2 July 1996.

## Vacuum Pump Sizing

The following calculations should be made to determine the minimum pump capacity of the vacuum system. This estimate provides enough pump capacity to cover allowances for system leakage, pump wear, and regulator leakage.

- Allow 35 CFM for basic effective reserve
- Add 3 CFM for each milking unit
- Add 0.5 CFM for each milk meter (or manufacturer specification if different than 0.5 CFM)
- Add CFM for other vacuum equipment according to manufacturer specification
- Add CFM for cleaning if needed.

The guidelines shown in Table 4 provide adequate airflow for efficient cleaning of properly designed CIP systems. Vacuum pump size is based on cleaning needs and is usually satisfactory for milking as well. To save on equipment costs, it is common to use two smaller used pumps together to equal the capacity of a larger new pump.

Table 4. Pump horsepower and number of milking units. Based on 10 cfm per HP for oil or lobe pumps and 7.5 cfm per HP for water ring pumps. (Bray, 1992)

Horsepower, HP	Oil or lobe pump		Water pump	
	Number of Milking Units	Pump Capacity, CFM	Number of Milking Units	Pump Capacity, CFM
5	1-5	50	1	37
7.5	6-12	75	2-6	56
10	13-20	100	7-12	75
15	21-35	150	13-24	112
20	36-50	200	25-35	150
25	51-67	250	36-47	188
30	68-80	300	48-57	225

## Sizing Main Vacuum Airline

Differences in vacuum levels between the pump and the receiver should not exceed 0.6" Hg (mercury). Recommendations for sizing the main airline relative to pump capacity, line length, and fittings are given in Table 5.

Table 5. Recommended minimum pipe size (inches internal diameter) for the main airline of a milking system. (Mein, 1995)

Vacuum Pump Capacity, cfm	Approximate length of main airline (feet)					
	10	20	40	60	80	100
	Pipe Size (inches internal diameter)					
50	2	2	3	3	3	3
70	3	3	3	3	3	3
100	3	3	3	3	3	4
150	4	4	4	4	4	4
200	4	4	4	4	4	4/6
250	4	4	6	6	6	6
300	6	6	6	6	6	6
350	6	6	6	6	6	6
400	6	6	6	6	6	6

Notes: The main airline is defined as the pipeline between the vacuum pump and the sanitary trap near the receiver. Calculations are based on a maximum vacuum drop of 0.6" Hg between the receiver and vacuum pump. The table includes an allowance for the equivalent length (feet of straight pipe) of one distribution tank, one sanitary trap, and 8 elbows.

## Swing Parlor Plan

The milking parlor is the heart of the entire milking center complex and is the most important part of a dairy operation. The area is quite complex and has a wide range of design options and alternatives. Figure 2 shows the different areas of the parlor which are described below. Figure 3 and Figure 4 show a plan and cross section view of the swing parlor with dimensions. The dimensions assumes Holstein cows with a swing stall design. If Jerseys are to be milked some of the design dimensions should be adjusted as indicated.

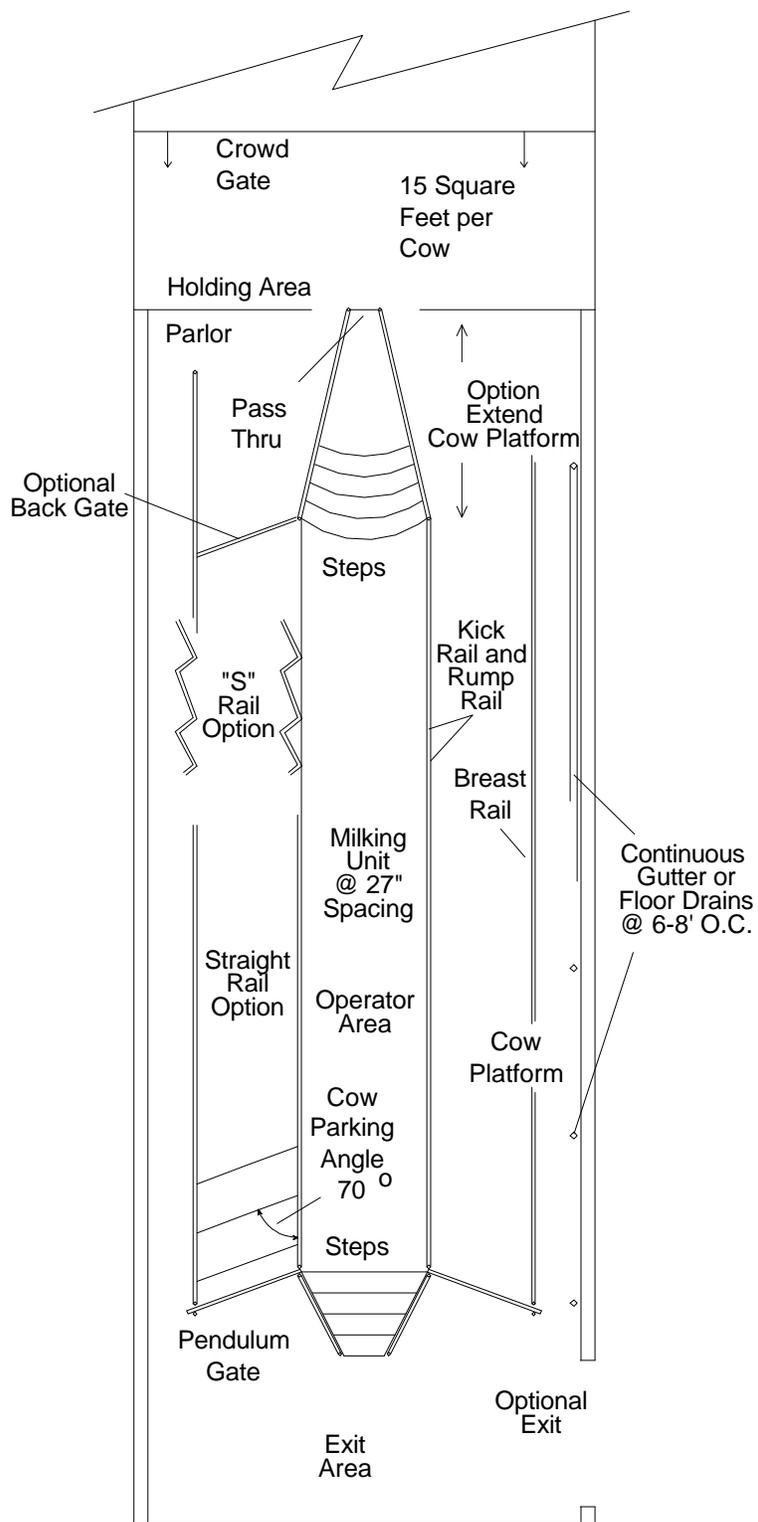


Figure 2. Swing Parlor Plan

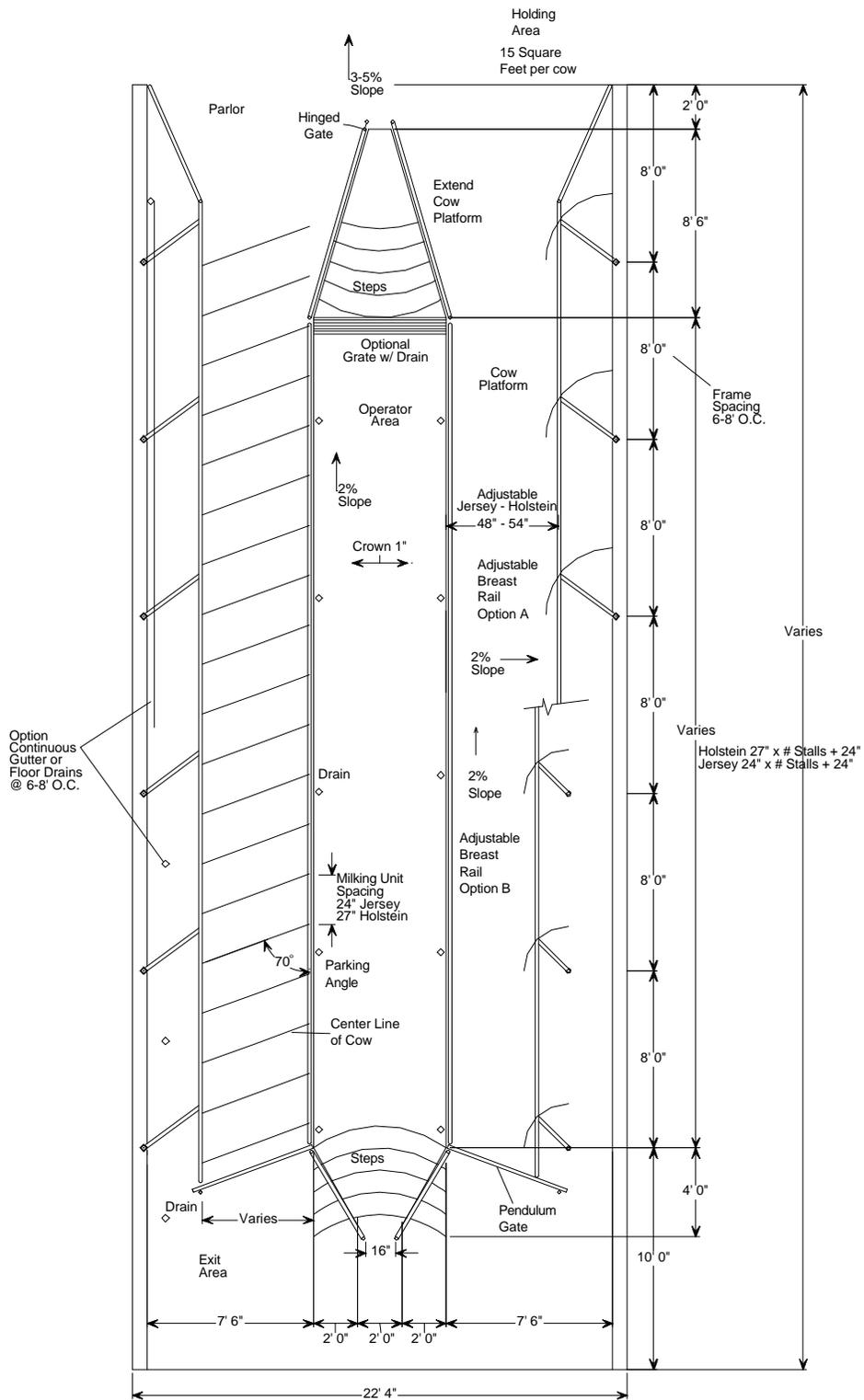


Figure 3. Swing Parlor Plan Dimensions



## Operator Area

The width of the operator area can vary between 5-8 feet. Additional width allows the operator to pass other people or obstructions such as waste baskets or carts easily and does not increase walking distance that much since most of the operator movement is over the length of the parlor and not the width of the parlor. Table 5 shows the length of the operator area for different sizes of parlors and milking unit spacings. The center of the operator area floor can be crowned 1 inch and slope down toward the pit wall. The operator area floor will usually have a similar slope (2%) along the length of the parlor to the slope on the cow platform to drain water to one end of the parlor. This slope (2%) is typically downhill toward the holding area end of the parlor.

The operator area length will depend on the type of stall used and the number of stalls on a side. Milking unit spacing for a parallel (90 degrees angle) and parabone (70 degrees angle) stall arrangement vary between 27-30 inches between milking units. A common swing parlor stall arrangement is a parabone arrangement where the cows are parked at approximately a 70 degree angle and the milking units are spaced 27 inches. The operator area length can be calculated by multiplying the number of stalls on a side by the spacing and then adding additional 6"-24" of length depending on entrance and exit gate needs. For example a swing 8 operator area length would be  $8 \times 27'' = 18'$  plus 2' or 20' long. Table 6 shows the dimensions for the operator area and holding area at several different milking unit spacings. Provide adequate space for the receiver group in the operator area.

## Cow platform

The cow platform should cantilever a minimum of 6 inches past the wall to provide an operator toe kick. Additional overhang length allows equipment to be positioned under the overhang and out of the operator area. (Figure 4) One option to create toe space is to pour a wall that tapers away from the operator area as it reaches the floor. (Figure 5) All controls for entrance and exit gates if used should be placed for easy access by milkers in the operator area. The operator area should also contain adequate hoses and drains for cleaning and cow prep including low pressure hoses for udder prep spray, post spray, and high volume low pressure hoses for clean-up. Drains should be placed in appropriate locations to collect water without ponding.

The cow platform should be at a comfortable work height level above the operator area floor. The milker should not have to bend or stoop during the milking routine. Udder visibility is the primary design consideration for deciding platform height. The cow platform height is mainly dependant on the height of the operator. Many recently built parlors use a pit depth that ranges from 38-42 inches. Parlor mats will improve worker comfort and can decrease the platform height if needed.

Since the milking unit is attached from behind the cow between the back legs the likely-hood of a unit being kicked off is reduced. For the simple swing stall design it is common that the cow platform be extended 2-3 cows beyond the operator area toward the holding area to position these cows behind the last cow to be milked, and in many cases no back gate is used. This

arrangement helps cow flow for the next loading. A pendulum gate or chop gate is used at the front gate location on the platform to allow quick stopping of the first cow during the next platform loading.

Table 6. Operator area length and holding area size.

Number of stalls per side	Milking Spacing @ Parking Angle <sup>1</sup> (inches)			Holding Area for 1 hour (square feet)	Number of Cows in Holding Area
	27" @ 70° (Minimum)	27" @ 70° (Typical)	30" @ 70°		
	Operator Pit Length (feet, inches)				
4	9' 6"	11' 0"	12' 0"	480	32
6	14' 0"	15' 6"	17' 0"	720	48
8	18' 6"	20' 0"	22' 0"	960	64
10	23' 0"	24' 6"	27' 0"	1200	80
12	27' 6"	29' 0"	32' 0"	1440	96
14	32' 0"	33' 6"	37' 0"	1680	112
16	36' 6"	38' 0"	42' 0"	1920	128

<sup>1</sup> Parking angle is approximate.

## Swing Stall Design

### Breast rail

The breast rail is approximately 30 +/- 2 inches above the cow platform. It should fit into hollow below the point of the shoulder. The adjustable rail allows adjustment of the line of cows to position the rump up against the rump rail and to position the udder as close as possible to the operator pit. The breast rail should be adjustable because the distance between the rump rail and the breast rail will be 54" +/- 3" for Holsteins and 48" +/- 3" for Jerseys. Once the breast rail is adjusted it is unlikely that its position will be changed much except for a seasonal milking system. It can incorporate the "S" rail design if desired.

### Kick (Hock) rail

The kick rail is usually a straight rail placed approximately 24" +/- 2" above the cow platform. This rail prevents cows kicking backward. The rail positions the cows leg and hoof on the platform so that the rear hooves are not likely to reach the platform edge and possibly step

backward off the platform. It can incorporate the “S” rail design if desired.

### Cow Platform Curb

To keep the platform simple no curb is used. In this design, the kick rail is placed 4” minimum toward the cow platform. (Figure 5) If a curb is used at the cow platform edge the kick rail should be positioned directly above the edge of the cow platform. This positions the cows rear leg and hoof on the platform so that it when stepping back the hoof will come into contact with the curb preventing the cow from stepping backward off the cow platform. The curb also acts as a manure splash guard for the worker. A 6 inch mild steel or stainless steel plate with a ½ diameter pipe welded to the top are options.

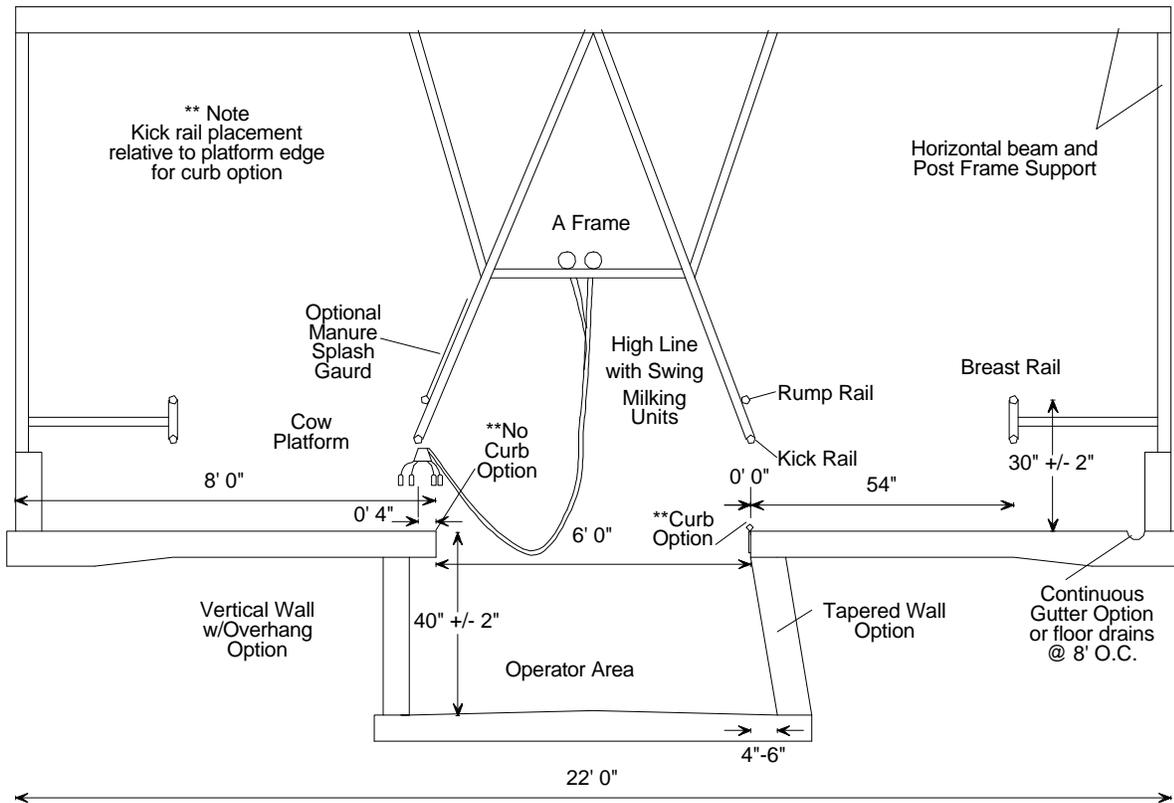


Figure 5. Swing Parlor Curb Options

### Rump rail

The simplest design for a rump rail is a straight rail placed just above the kick rail (approximately 8”) at approximately the same height as the breast rail. It can incorporate the “S” rail design if desired.

## Indexing

Indexing of the cows can be accomplished by using an “S” rail design for kick rail and rump rail, or the breast rail or both rails. The “S” rail design helps to index the cows on the platform by positioning and separating individual cows from each other. This “S” rail can impede cow flow and it is usually not necessary for parlors smaller than 12 on a side. However for large parlors (more than 12 on a side) it may be beneficial to the milking routine to index the cows and keep them from crowding/crushing on one end of the parlor or the other.

## Stall Frames

Figure 6 shows two options for the frames that support the rump rail. These frames support the milk line, vacuum line and any other equipment needed in the operator area. For safety design, these frames are usually supported from above reducing the need for posts on the cow platform that could interfere with udder access or become pinch points between a cow’s leg and the post.

## Manure splash guard

In a well run parlor with minimal agitation of the cows, only 1 or 2 cows per hundred are likely to drop urine or manure in the parlor. Udder and cow visibility are much better if no manure splash guard is used. However some milkers prefer to have more protection. A manure splash guard can be placed above the rump rail to direct manure to the platform instead of the operator area. This along with a cow platform curb at the edge of the platform can reduce manure splatter. Grates at the rear of the cow platform are not comfortable for the cows to stand and may cause cows to hesitate as they load which can reduce parlor throughput.

In most parallel stall designs marketed a manure pan is incorporated into the design. This manure pan is positioned just under the cows tail and is designed to intercept manure and urine before it falls to the cow platform. Docked tails are also suggested to maintain clean cows.

## Chop Gates or Guillotine gates

Chop gates are used on the front of the parlor to stop the first cow of the next loading quickly. This is needed especially if a back gate is not used in the parlor design, because the first cow of the next loading is usually directly behind the last cow milked of the current side. Several manufacturers sell a chop gate but many farmers also have built their own design.

## **Heating and Ventilating the Parlor**

In the northern climate heat will be needed for part of the year. This can be done with forced air or radiant heat systems. A recent option used by some farms is to place in floor heat in the new concrete floors. A hot water heater, boiler or outside wood fired boiler can be used to heat the antifreeze solution which is pumped through PET tubing placed in the concrete floor and alleys.

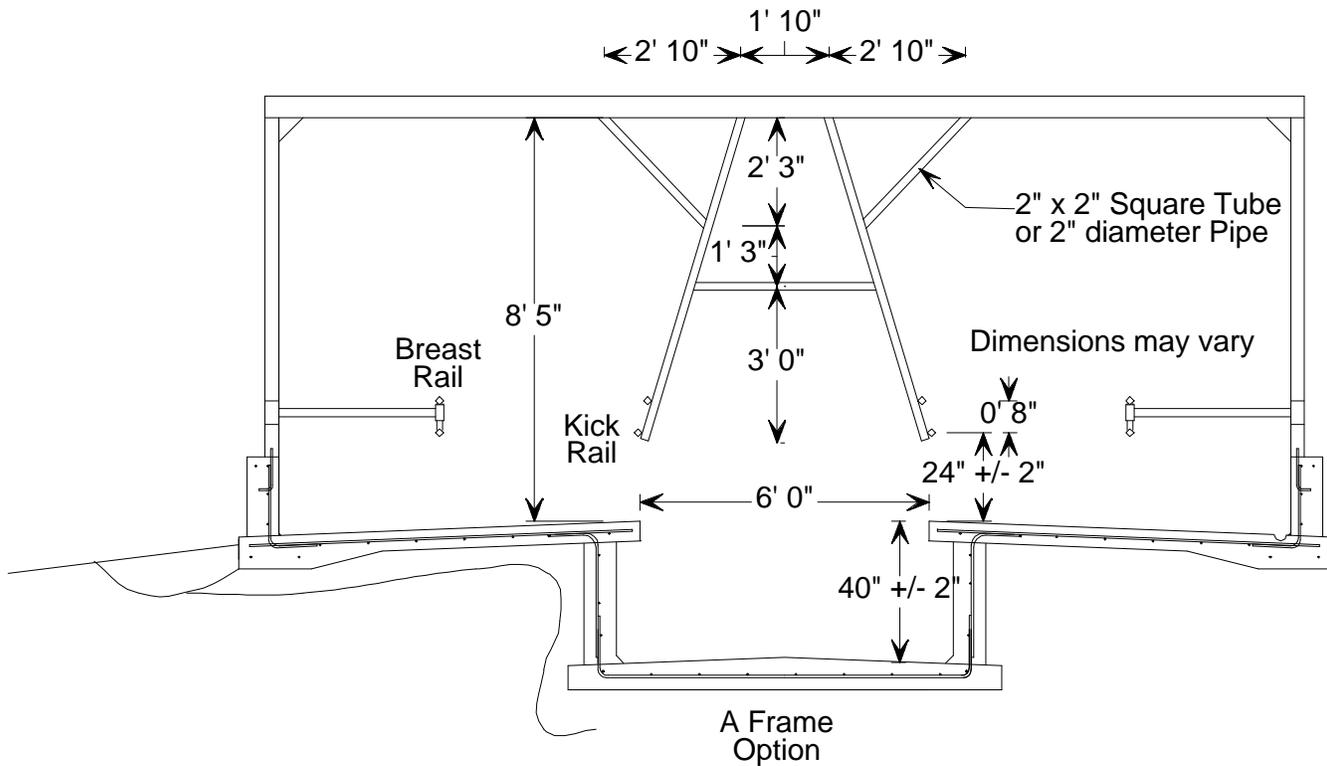
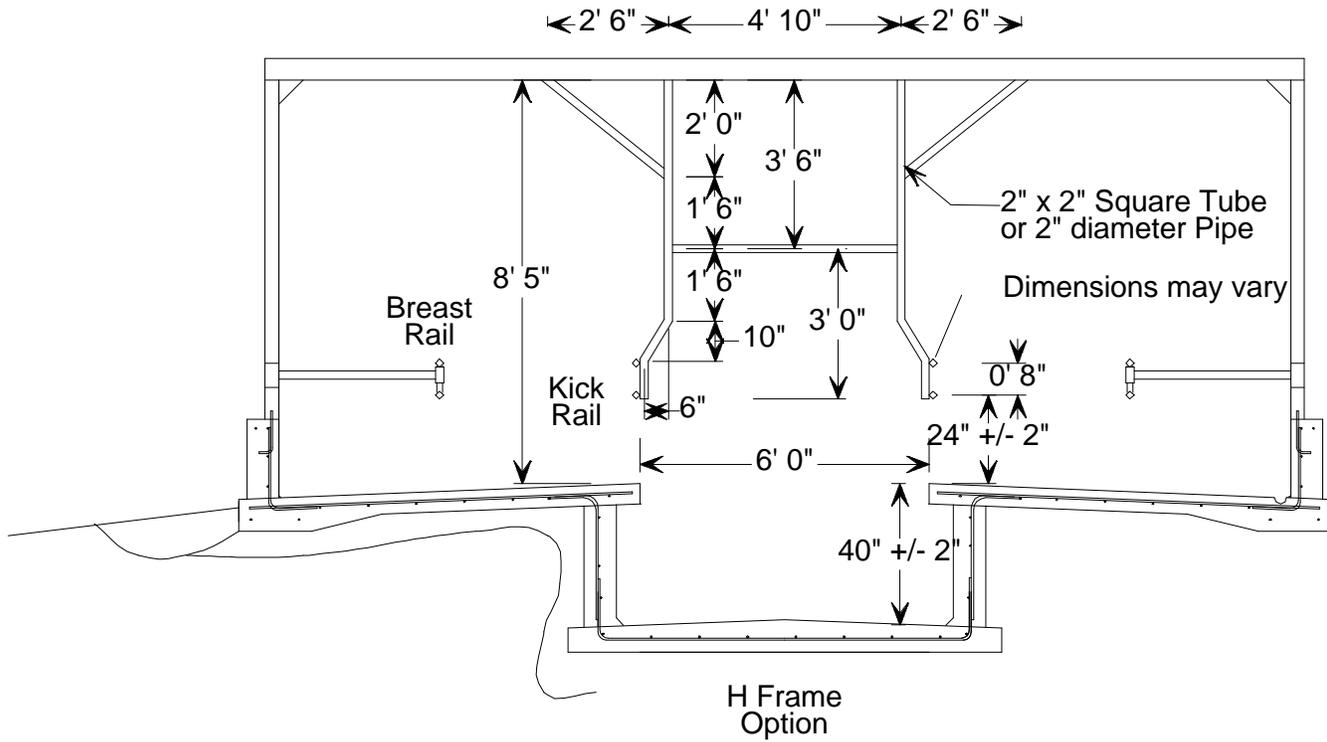


Figure 6. Swing Parlor Frame Options.

Zone heating is recommended. For example zones in the cow platform, in the operator area, and return lanes might be used. Each zone is controlled by a separate thermostat, which can be set to heat each surface to an appropriate temperature.

Ventilation is important in any parlor design. It should be considered in the initial plan. Hot weather ventilation can be achieved with tunnel ventilation, or open side wall designs. Cold weather ventilation can be achieved with negative, positive or neutral pressure design with appropriate fans and inlets/outlets. Paddle fans can help move air in the parlor and increase operator comfort.

### **Lighting the Parlor**

There should be a minimum of 50 candles of illumination in the udder area. Place lighting fixtures to minimize shadows in the udder area. Place fixtures parallel to the length of the operator area to allow light to penetrate down between the cows. A well-lit parlor will be a pleasant place to be compared to a poorly lit dungeon common with older parlor designs.

### **Cow Platform and Operator Area Drainage**

Cow platforms and the operator area should have the proper slope to move water in the desired direction. Floor drains at 8' o.c. can intercept water so that washing down does not require chasing puddles the entire length of the parlor. Another option is provide a continuous floor gutter along the interior of the side walls that can intercept wash water like a rain gutter. Plate cooler water and CIP wash water can be collected to recycle as parlor wash down water. A 50/50 blend of gray water and fresh water has been used successfully and kept odors to a minimum. A collection sump and trash pump placed in the operator area can be used to collect water in this area.

### **Return Lane(s)**

Cow exit and return lanes should allow for straight cow flow as much as possible. In many cases it is necessary to return the animals to the rear entrance of the holding area. This will require a return lane adjacent to the holding area. Single returns allow easier cutting of animals into pens on one side of the parlor as they exit. This area is usually available for placing a few pens along the return lane. Double returns require cutting gates and pens on both sides of the parlor. If width is limited it may not be feasible to have dual returns. When cows exit out the front of the parlor, a wide platform to hold one side of animals is desired to allow the cows to move out of the way for the next loading. Most times the exiting cows do not immediately exit the parlor, and may lounge about for a time, which can interrupt cow flow. A minimum of 6 feet is desired for the cross over. 8' is even better. Exit lane size for one cow is 36" wide with a minimum of 30" wide. If a double wide return lane is desired it should be 72" wide. Anything between 36" and 72" is not desired as it will tend to get blocked with two animals if they try to pass each other. Some farms have made the return lane wide enough to allow skid steer loader access for cleaning.

## **Crowd Gate**

A crowd gate is necessary to train cows to enter the parlor for the first couple of weeks and may not be required after the training period. The simplest crowd gate design has a horizontal member perpendicular to the length of the holding area. This horizontal member is supported on 2 wires or pipes running the length of the holding area. Spaced vertical chains or sections of conduit pipe hang from the horizontal. These verticals can be pulled back like a shower curtain to allow entry of the cows into the holding area and pulled shut to enclose the holding area. A garage door opener control or manual control can be used to move the gate. A bell or buzzer should also be used to train the cows to move on the sound and not have to be pushed by the crowd gate. This design can be built for under \$500. Milkers should not leave the operator area to bring cows into the parlor unless absolutely necessary. This just trains the animals to wait for the milker to enter the holding area before entering the parlor. A pass through from the operator area into the holding area should be available when it is necessary to go into the holding area.

For best cow flow the cows should move in a straight line from the holding area into the parlor and exit straight out. The holding area should be sloped 3-5% up toward the parlor entrance and sized for at least 15 square feet per cow and a holding time of 1 to 1-1/2 hours maximum. Table 6 shows the size of holding area needed for one hour or less. Cows should be funneled into a single line just before entering parlor. A back gate can be used to control loading of the cows. If a back gate is not used, narrow down the entrance and have 2-3 cows on the platform lined up behind the last cow being milked.

It is common to keep the area between the holding area as open as possible. Use overhead doors to keep the openings as large as possible. Small entry doors can become a bottle neck for cow flow. Plastic freezer door strips can be used on large openings to reduce drafts.

## **Other Parlor Options**

Many of the pieces of technology available to parlors is available to the remodeled parlor. Indexing, computerized ID and data collection, and automatic takeoffs (ATOs) can all be adapted to a swing parlor design and are in fact available from manufacturers.

ATO are a common option available on remodeled parlors. Rope ATOs are the most common since they adapt easily to many different parallel or parabone parlor designs where milking units are attached between the rear legs. Arm takeoffs can be used with herringbone parlors when milking units are attached from the side of the cow.

CIP is one option that can be added at a later time if the budget can not be found to do it now. The system should be designed to have the space to add it at a later time without major renovation or cost. In some remodeled parlors it may not be practical or too expensive to finish the interior of the building adequately to allow CIP to be installed. This is common in old barns

where it may be difficult and costly to finish off old beams and stone walls. In this case, it is common to move the milking units into and out of the parlor from the wash station housed in the original milk house just like it was in the stall barn milking system. This does increase set up time but can be a way of saving money.

Milk meters and computerized cow ID is available in swing parlor designs. Not all manufacturers have adapted the technology to the swing parlor design, but it is just a matter of time and at least one manufacturer has already made an attempt at installing it in a swing parlor application.

## **Feeding Area**

A common question asked regarding parlors is whether to feed in the parlor or not. It is usually simpler to deal with the two issues separately. Feeding in the parlor is also one more job that has to be done that takes time away from the milker which can reduce cow throughput. However for graziers that job may more easily be done in the parlor compared to at another place and time in the chores.

Parlor feeding may improve cow entrance but it can also hinder cow exit which can affect parlor throughput. Time and motion studies showed that cow throughput was severely compromised when feed was given in the parlor. Cows tend to stand quieter when not fed in the parlor. Cows may not spend enough time in parlor to eat all grain needed, so if grain is fed in the parlor feed only a small amount (3-4 lbs) to all the cows. The parlor can stay cleaner and has less equipment in the way which can hinder cow flow.

## **Initial Parlor Startup**

Parlor startup and training is a high stress activity for both the cow and the operator. In seasonally calved herds, it may come at calving which only adds to the stress. Minimizing the stress will help reduce potential problems but will not eliminate them. The new milking routine should be defined before hand so that everyone milking is familiar with the steps. In a seasonal herd the training of new heifers may be more difficult than with the older cows.

It has been suggested that the parlor be wet down to ease cleanup and that manure be spread around a new parlor to cut the odd smells of new concrete and equipment. On the initial visit, cows should be allowed to enter the holding area and parlor on their own. This could be done for several days, increasing the pressure to move through the parlor. At some point in this training the cows should be held in the line but not milked, released and allowed to exit the parlor. On the first day of milking additional help should be available to move cows into and out of the parlor if necessary. The goal should be to have the parlor operating with the correct number of operators in the first month if at all possible.

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