

Milking Center Options

Douglas J. Reinemann, Ph.D.

University of Wisconsin - Madison, Department of Biological Systems Engineering
Milking Research and Instruction Lab

Milking can make up over ½ of the labor expended on a dairy farm. Labor efficiency for milking can range from 20 to over 100 cows milked/person/hour. The milking facilities can make up 20 to 60 percent of the total capital investment in a dairy. The combined annual cost of typical Midwestern milking facilities and the labor to operate them can range from 5 to 30 percent of the cost of producing milk. Proper planning, construction, and operation of the milking facilities can thus have a significant influence on the profitability of a dairy enterprise. The following table gives some estimates of the annual cost of milking facilities and labor for different milking systems.

<i>Milking System</i>	<i>Low</i>	<i>Typical</i>	<i>High</i>
Round-the-Barn Pipeline 30- 100 cows	\$1.15/cwt.	\$1.50/cwt.	\$2.25/cwt.
Flatbarn Parlor 50 - 150 cows	\$1.10/cwt.	\$1.20/cwt.	\$2.80/cwt.
Elevated Parlor 300 cows	\$0.85/cwt.	\$2.00/cwt.	\$3.50/cwt.
Elevated Parlor 600 cows	\$0.75/cwt.	\$1.80/cwt.	\$2.50/cwt.

Assumes \$10/hr labor cost, 20,000 Lb./milk/cow/year

While it is possible to reduce the cost of production and increase profitability of a dairy operation by investing in milking facilities it is also possible to increase the cost of harvesting milk and reduce profitability. The situation with the greatest risk is the herd expanding to 300 cows and building an elevated parlor. Close attention must be paid to the level of capital investment to ensure these operations remain profitable while expanding.

Dairying is a risky business. The rate of return is typically low compared with the level of capital investment required. Profitable dairying requires highly specialized knowledge in a large number of different subject areas. These are some of the reasons that dairy farms have continued to be family-owned businesses rather than investor-owned or corporate enterprises. Increasing the debt load increases the risks associated with a dairy enterprise. Reducing debt and financial risk will give the dairy owner/operator more management options for dealing with other risks such as volatile milk price, bad weather, poor feed quality and disease. This paper will present options for milking facilities to maximize profitability for expanding dairy operations in the Midwest and keep them competitive with dairy producers in other parts of the country and world.

Level of Capital Investment

It is instructive to compare the relative investment in different types of milking facilities over a range of herd sizes as a measure of the efficiency of capital investment. A useful rule of thumb to compare the level of capital investment is the ratio of the initial cost of milking facilities to the gross annual milk sales. This ratio is typically Less than 20 % for large western herds.

Example: 1000 cow Western dairy
\$2,400,000 Gross annual milk sales
\$480,000 Total Milking Center Cost (Double 20)
Ratio of milking center cost to gross milk sales = 20%

A typical scenario for a multifamily, expanding midwestern dairy would be as follows:

Example: 300 cow midwestern dairy
\$720,000 Gross annual milk sales
Ratio of milking center cost to gross milk sales = 20%
\$144,000 Total Milking Center Cost

A single-family operation would typically have fewer cows and the following scenario:

Example: 100 cow midwestern dairy
\$240,000 / year Gross milk Sales
Ratio of milking center cost to gross milk sales = 20%
\$48,000 Total Milking Center Cost

These simple examples help to approximate the level of capital investment in milking facilities to keep midwestern herds competitive with large herds in other parts of the country. Further details on the type of milking facilities that can be constructed for these budgets are presented below.

Flatbarn Parlors

Flatbarn parlors are best used on 50 to 150-cow herds as a transitional facility while building cow numbers and reducing debt. Flatbarn parlors are well suited for installation in existing stall barns. A recent study (Chastain and Reinemann, 1995) showed the total project cost of flatbarn parlor conversions ranged from \$6,000 to over \$60,000. The average throughput of 13 flatbarn parlors was 45 cows per hour with a single operator. There was little difference in cows milked per hour between back-out and walk-through stalls. The best labor efficiency was achieved with one person milking and single cow movement rather than moving cows in strings.

The total project cost should be kept below \$10,000 to \$20,000 to make these facilities competitive with other milking systems. This will require use of an existing milking system and no major structural modifications to the old barn. Most flatbarn parlors use automatic detachers, although a number of producers have achieved excellent labor efficiency using only end-of-milking indicators. The key to efficient milking in a flatbarn parlor is efficient cow flow with one person operation. If the initial cost of a flatbarn parlor is kept under control, it is an effective way to improve profitability and reduce financial risk during gradual herd growth.

Milking Parlor Labor Efficiency

It is clear from numerous time and efficiency studies that the largest single variable in the success of the milking operation is the care the operators exercise in performing their function. The efficiency of labor in milking parlors covers a very wide range from under 50 to over 100 cows/person/hour. The biggest single factor in determining the number of cows milked per hour is the time taken to prep cows and attach milking units. The desired milking routine and capabilities of the labor should be determined before selecting parlor type and size. The entire milking routine must be performed in the time it takes to milk a cow in order for the operator to “keep up” with the parlor. The following table gives the average machine-on-time for varying

levels of production and milking frequency. These numbers include 30 seconds for an automatic detacher to operate.

Herd Average	2x Milking	3x Milking
15,000 lb.	5.5 min	****
23,000 lb.	8.0 min	5.5 min
30,000 lb.	10.5 min	7.0 min

It may take from 2 to 10 minutes to release one group of cows from the parlor and load another group for milking. Subtract the cow movement time from the machine-on time to estimate the time available for post dipping before release, and prepping cows and attaching units. A more detailed analysis of expected labor efficiency and annual cost of milking facilities can be performed with the Milking Center Advisor software available from the University of Wisconsin Center for Dairy Profitability world-wide-web site (<http://www.wisc.edu/dairy-profit>).

Typical milking rates are shown in figure 1 for scenarios with and without recommended preparation procedures. The differential labor cost to milk 300 cows 3 times per day with prepping (75 cows/person/hour) versus no prep (90 cows/person/hour) equates to a milk income of 200 lb./cow/yr. If the extra time taken to prep cows will yield more than 200 lb./cow/year it is a wise economic decision to prep cows.

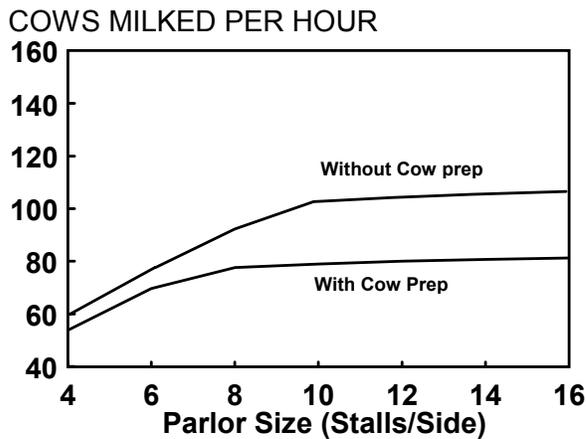


Figure 1. Cows milked/hr. one operator

Some of the options available for milking facilities will improve labor efficiency (cows milked/person/hour). The annual cost of these options versus the labor savings is the first test of whether to invest in them. In the scenario presented in figure 1 the investment in a parlor larger than a double 8 produces little or no increase in labor efficiency if cow prep is practiced, and therefore is not a good use of capital.

There are other milking facility options that have no effect on labor efficiency (cows milked/person/hour) but may improve the work environment. It is helpful to frame these decisions as a balance between the increased annual costs of these amenities versus the

reduced annual wage paid to the operator. As the key to success of any milking facility is the quality of the operator, the improved cash flow situation resulting from reasonably priced milking facilities may be best used to increase the wage of the owner/operator or other qualified labor.

Elevated Parlors: 100 to 400 cow herds

If it is anticipated that the size of the milking herd will be in excess of 100 cows, plans should be made to build an elevated parlor as soon as cash flow allows. In order to keep from going broke it is important to keep the level of capital investment in line with the income stream from

the herd. A “low cost” milking parlor can be built for under \$100,000. Until the parlor is operated 24 hours per day, the fundamental goal for profitability is to keep the capital cost of the parlor low. When the herd size has grown to the size that round-the-clock milking is practiced, the goal for profitability shifts to increasing the number of cows milked per hour to allow further herd expansion. This shift in objective and economics usually occurs at a herd size between 400 and 700 cows.

In order to keep capital investment in line with cash flow and still allow for future expansion it is generally most practical to build a new building for the elevated parlor rather than retrofit an existing building. It is important to build the milking facility in a location that will be well integrated with future cow housing and will also allow for future expansion of the milking facility. Some design concepts for the expandable ‘Wisconsin Idea Parlor’ to keep expanding Midwestern dairies profitable are presented in the attached figures.

Elevated Parlors: 600 cow and larger herds

Two possible options exist when milking facilities operated by one person reach the limit of their capacity (operated 24 hours per day) and further herd expansion is desired:

- 1) Build a larger parlor and add a second operator,
- 2) Build two one-person parlors at the current site, or
- 3) Develop a second site with a new one-person parlor and animal housing.

Serious consideration should be given to developing two sites, each with their own milking facilities, animal housing, manure storage and feed storage. Several factors indicate that two sites are better than one.

- The majority of the economies of scale of facilities are achieved at cow numbers of 400 - 600.
- Labor efficiency will always be better with two one-person parlors compared with one two-person parlor.
- A recent study by Thomas et al (1995) showed that two small parlors were considerably more efficient and profitable over 15 years of operation than one large parlor.
- The environmental risks and regulations associated with two smaller versus one large facility are considerably reduced.
- The cost and complexity of applying manure to the land are reduced if the manure storage can be located in the center of the land area to which it will be applied. Hauling distance and cost for forage can also be reduced.
- Risks associated with transmission of disease are reduced with two smaller facilities.
- Two ideal building sites may be easier to locate than one large site

Milking Parlor Design Considerations

A milking parlor building should be designed around the milking system. Milking systems have specific requirements regarding the slope of pipelines and the physical relationships between animals and machines. Other physical relationships, while not absolutely required, greatly improve the performance of the milking system. Placement of a milking system in a building not designed specifically for it can result in reduced milking and cleaning performance.

Several requirements of the milking system influence building design. The most important of these is the slope of the milklines. Increasing milkline slope greatly increases the carrying capacity of milklines. Pipeline length and slope, position of the receiver, and mounting requirements of ancillary equipment such as milk meters, weigh

jars, and pulsators, determine the required clearances. All pipelines in the milking system must be sloped to a drain point. The slope of the other piping systems generally conforms to that of the milklines. The slope requirement for pipelines can cause clearance problems especially if the cow platform and parlor pit floor slope in the opposite direction as the milkline. Consideration of slopes and clearances is especially important if a parlor to be expanded at a later date. The milking system should be designed before the parlor, milk room, and utility room so the building will not place limitations on the milking system design.

Efficient and effective CIP system designs require pipe lengths and number of fittings be kept to a minimum. This will reduce the installation and operational cost of the CIP system as well as improve both milking and cleaning performance. The receiver should be located to minimize the number of bends and fittings in the milkline and should not interfere with operator movement during milking. Receivers are most commonly installed in the operator area, in breezeways, or in the milk room. The wash sink is generally located near the bulk tank inlet to facilitate the piping switch from the milking to cleaning configurations. The length of piping from the milk room to the parlor should be kept to a minimum to reduce cleaning water volume, heat loss during cleaning, and difficulty controlling circulation. The utility room should be located to minimize the length and number of fittings in the main airline connecting the vacuum pump(s) with the distribution tank and/or sanitary trap.

References

- Chastain, J., and D.J. Reinemann, 1995. Performance and Cost of Automated Flat Parlors. Designing a Modern Milking Center, Northeast Regional Agricultural Engineering Service National Conference, Rochester New York, Nov 29 - Dec. 1, 1995.
- Kammel, D.W., 1995. Swing Parlors. Designing a Modern Milking Center, Northeast Regional Agricultural Engineering Service National Conference, Rochester New York, Nov 29 - Dec. 1, 1995

Using Better Technology Through Planning a Parlor for the People by Sevie Kenyon

How to Save Money by Building into a Milking Center

Start your plan for the future as inexpensively as you can without building yourself into a box. You've heard that advice before. Here now is a blueprint you may use to follow the advice.

For as little as \$50,000 to \$80,000 you can build a fully functional milking center. You then have the option to add more features and capacity later as your business grows.

Doug Reinemann, University of Wisconsin biological systems engineer, says this "design process" should have a useful life of up to 40 years. The process is based on three principles: Start by investing in the building; use existing milking equipment whenever possible, and make sure the building is designed to change.

Step One

1. Holding area: designed for largest potential group size in the freestall up to 100 cows. If you have a 400 cow barn, the holding area is geared towards four groups. The holding area features curtain sidewall, natural ventilation with an open ridge similar to a freestall barn.

2. Parlor: Features to include are a floor slope of 2% toward holding area; a cattle crossover for good cow flow with a simple single return lane to lower costs. In the early stages it's possible to use simple, homemade stalls to further reduce costs.

Other cost-saving features are the ability to use existing highline swing 8 system with 2 inch pipeline or double 8 with three inch pipeline.

It's important in this stage to provide a for a tunnel into the milk room for future lowline and an overhang in the parlor to place lowline equipment.

Make the platform wide enough now so if you want to add rapid exit and dual cow returns lanes in the future you can.

3. Milk room

4. Utility room

5. Office

Step Two

Your first major upgrade

6. Add lowline receiver and low level pipeline.

7. Remove cross over and add dual returns and rapid exit stalls and increases the number of stalls to double 10.

Options include autodetach, milk meters, cow identification, automatic cow snorting gates.

Step Three

Growing onward

8. Expand the building. Expand the utility room into the former office area, add a breezeway, add a second wing for expanded office, employee breakroom, secure storage and so forth.

9. By tearing out the face of the building, you may add more parlor stalls. You can go to a double 16 with a three inch low line without doing a thing in the milk house.

In-Budget Parlor

New Design Allows Growing Dairies to Modernize Without Going Broke

The decision making process starts with the 20% rule. Compare the initial cost of a milking parlor to your expected gross annual milk sales. Generally, what you can afford to spend on a milking center is in the neighborhood of 20% of your expected gross annual milk sales.

Examples: if you expect to sell \$720,000 worth of milk in a year you can spend about \$144,000 to build a milking center. If you can market \$240,000 worth of milk per year you can afford to spend about \$48,000 for your new milking center.

This rule of thumb on parlor investment holds true across many herd sizes, remarks Doug Reinemann, University of Wisconsin, biological systems engineer. A 1,000-cow dairy expecting to sell \$2,400,000 worth of milk can afford to spend about \$480,000 for a new milking center.

Reinemann arrives at his 20% rule of thumb on parlor investment with growing dairy farms in mind. Dairies making a transition to larger herds are in a touchy economic position.

Let the economics of your plans tell you how much you have to invest in a milking center," Reinemann says. It's actually possible to increase the cost of producing milk by over investing in a milking center.

Keeping your costs down should improve profit potential and provide more options for the producer to deal with ups and downs in the dairy business," Reinemann says.

Keep in mind that a rule of thumb is based on generalities. "There are a lot of things to consider," says Mark Juett, senior marketing manager, Alfa Laval Agri. "For example, is the farm totally dairy or is it diversified with crops, cash crops or specialty crops.

"Once you have arrived at a comfortable ceiling in what you're going to spend on a milking center for your growing dairy, you can begin to look at design

options. Economics often dictate one style of milking center versus another.

Milking center efficiency also affects profit potential. Milking center efficiency including labor and the milking routine should be considered prior to spending money.

The number of cows that go through a parlor in an hour can range from 50 to more than 100, Reinemann says. Cow preparation is the biggest single factor affecting parlor efficiency.

Other influences on parlor efficiency include operator quality, milking machine attachment and detachment, milk production per cow, number of milkings and the flow of animals in and out of the center.

Yet another rule of thumb Reinemann uses is the "double 8" or "single operator" concept. When trying to get the most efficiency out of a milking center, the double 8 (eight stalls per side) run by a single operator is about the best combination.

"Once a milking center operated by a single milker has reached its capacity, it is often better to develop a second milking center than to add more stalls and a second milker," Reinemann says.

In many places, the Midwest in particular, two milking centers are better than one, he reasons.

This is because of several factors:

- Once your herd is between 400 and 600 cows, you have already captured most of the benefits of economy of scale.

- Labor efficiency is always better with two, single-operator parlors than one, two operator's parlors.

- Research indicates two parlors are more profitable over time than a single, larger parlor.

- Environmental risks and regulations are often reduced when you compare two smaller dairies to one large dairy.

- Manure management and feeding systems are more manageable with smaller units.

- Herd health is more manageable.

- It's often easier to find good building sites for smaller dairies in Midwest environments.

Once you have worked through these basic issues Reinemann says it's time to look at parlor specifics. He has developed a "Wisconsin Idea" approach to parlor construction.

Plan Right From the Start

Milking centers have attributes you must account for. Doug Reinemann, University of Wisconsin, biological systems engineer says it's best to build a building around the attributes of the milking process than to try to jam the requirements into a building designed with other things in mind.

If you plan it right from the beginning, you can start out with a low-cost milking center that can grow and improve as your herd grows. We've tried to be as flexible as possible," Reinemann says. Milking center costs are a significant part of the total capital investment on a dairy."

By following a plan such as the one Reinemaun outlines, you can reduce some of the up-front capital investments often made in milking centers. Typically, when a milking center is built with future growth in mind the cost of that future expansion is added to the front end of the total process.

If you buy into the "Wisconsin idea parlor" you'll only add more milking stalls and square feet of building area when you need it. In many instances, you'll be able to use existing equipment in the milking center or utilize such lowcost concepts as highline "swing" parlors to get you started.

"It's possible to get you into a platform type of parlor for \$50,000 to \$80,000 if you're able to use existing equipment," Reinemann says.

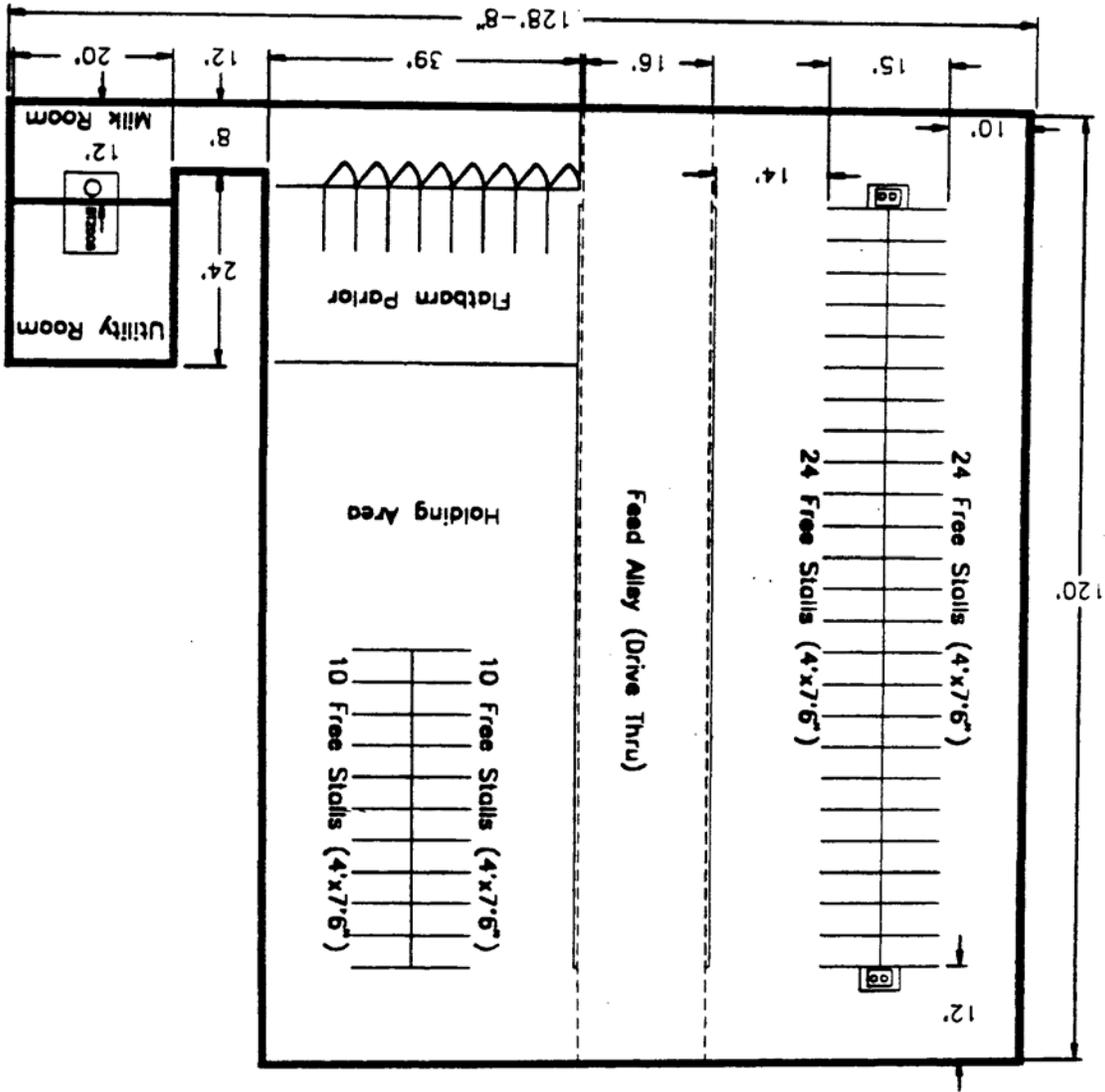
Things to Consider

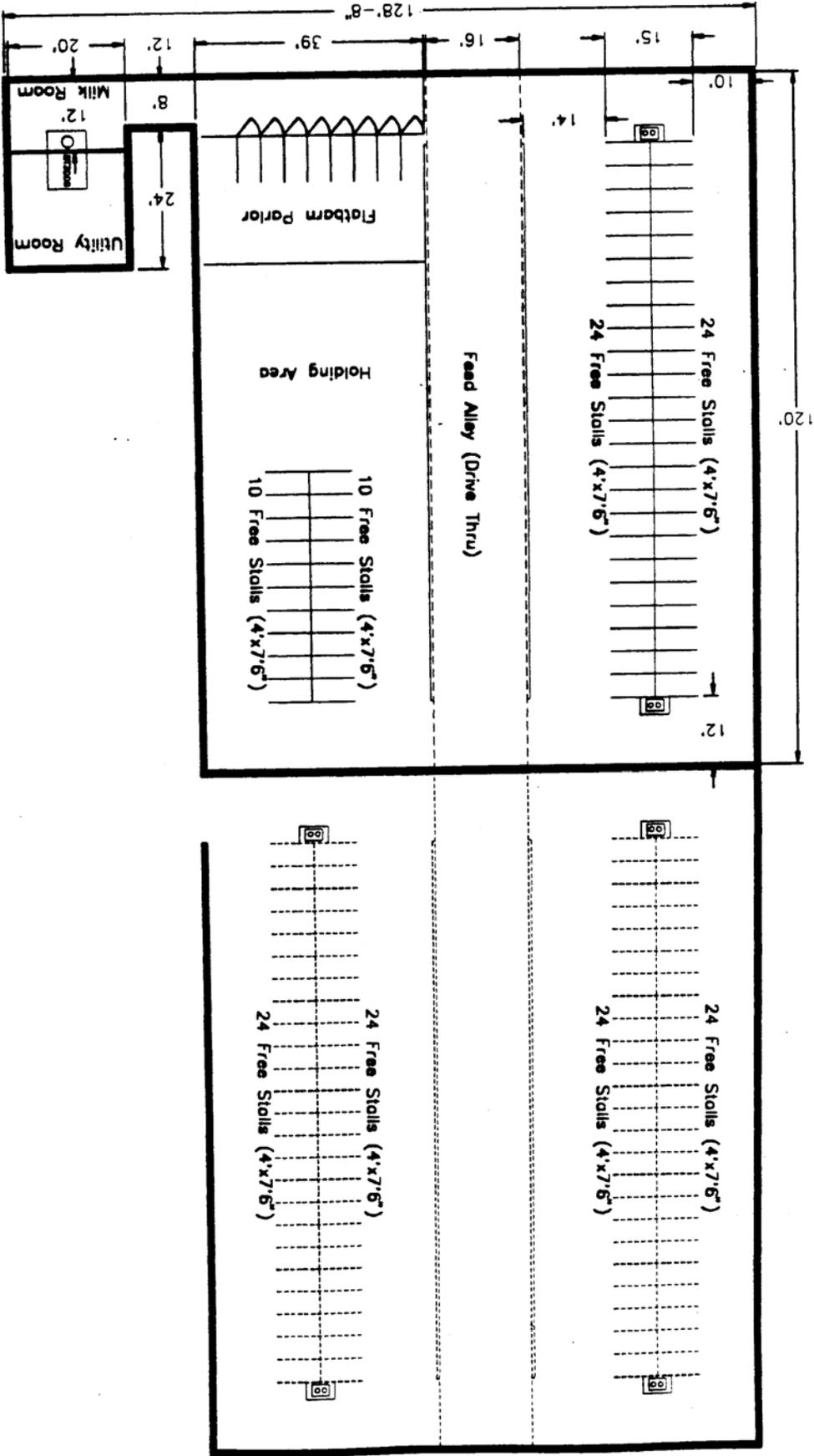
Pipeline slope. Pipeline slope affects the capacity of the line. The slope needed to make the pipeline work best affects everything else about the milking center such as placement of the equipment, other piping systems, cow platforms and parlor pit slopes and specifications, clearances and future expansion plans.

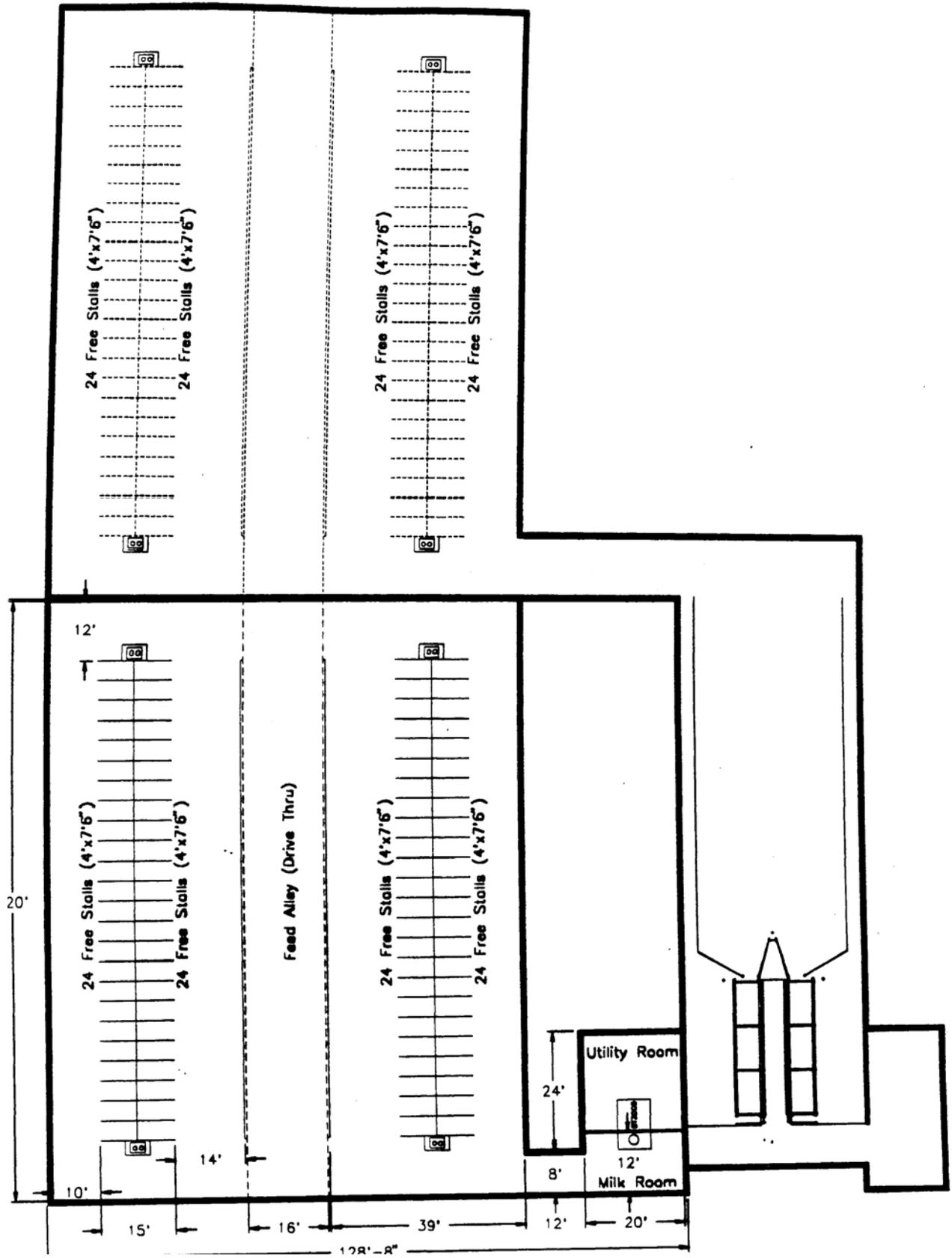
Clean-in-place (CIP) features. The best CIP systems have the minimum pipe length and the least number of bends and fittings possible for efficient operation.

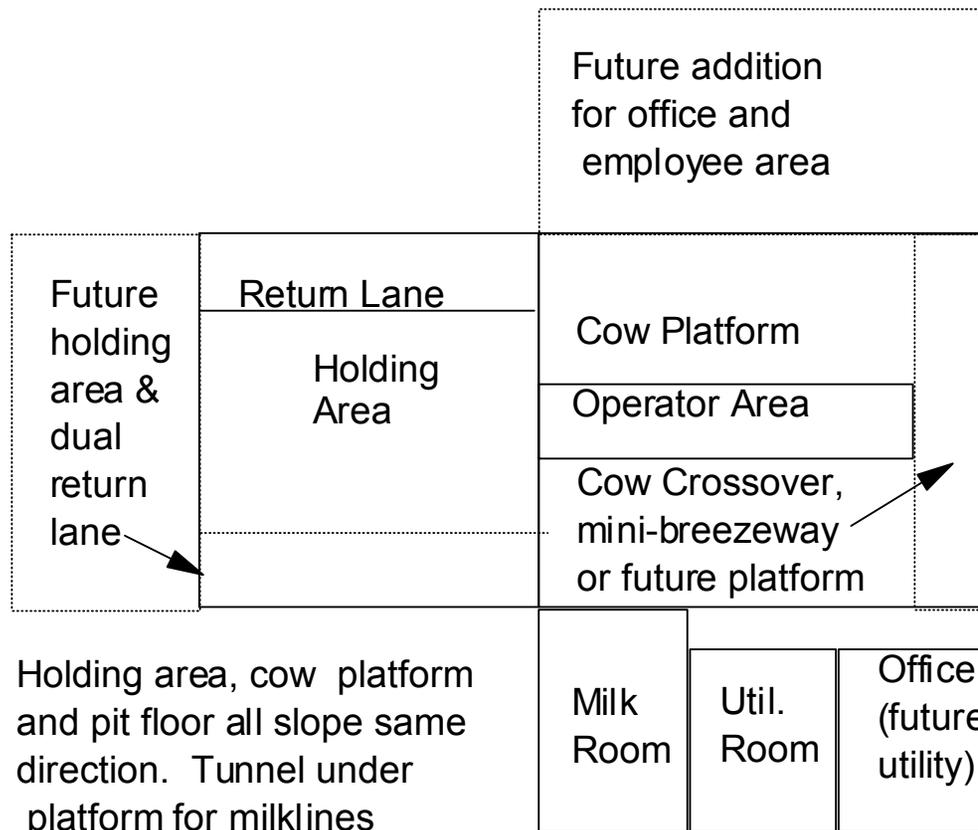
Location of the receiver. Take care to place the receiver jar out of the way and to minimize milk line length, bends and fittings.

Location of milk rooms and utility areas. Again, place these areas to reduce the total length of needed pipes, fittings and bends and to accommodate future growth.





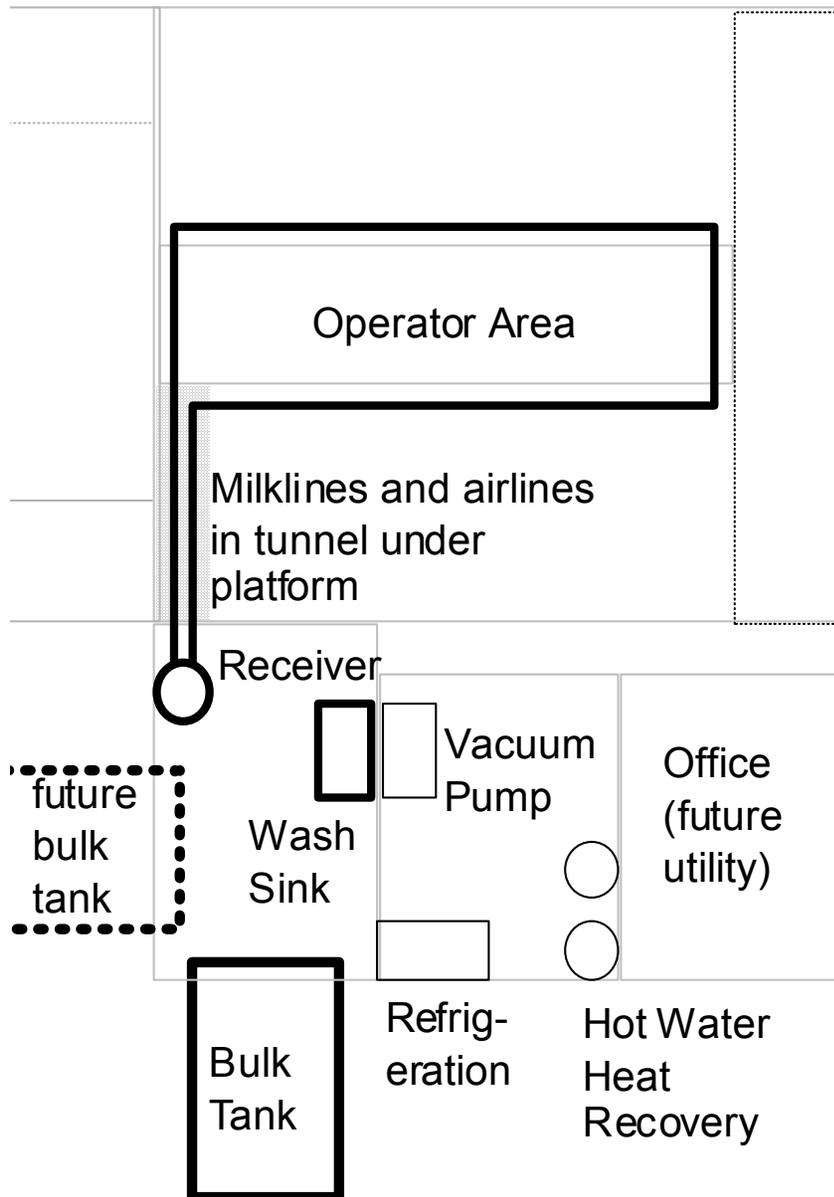




Holding area, cow platform and pit floor all slope same direction. Tunnel under platform for milklines and airlines.

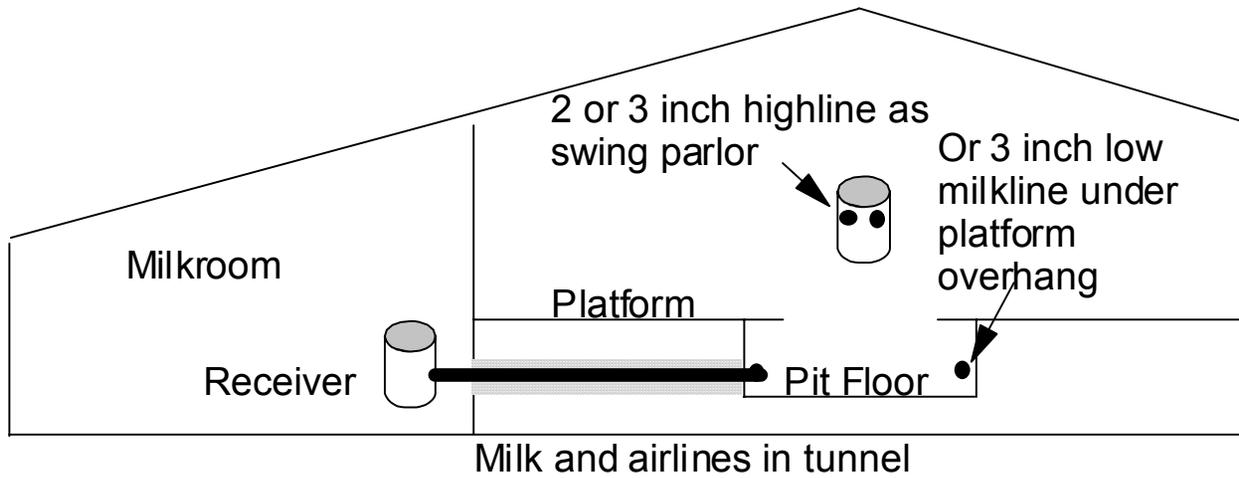
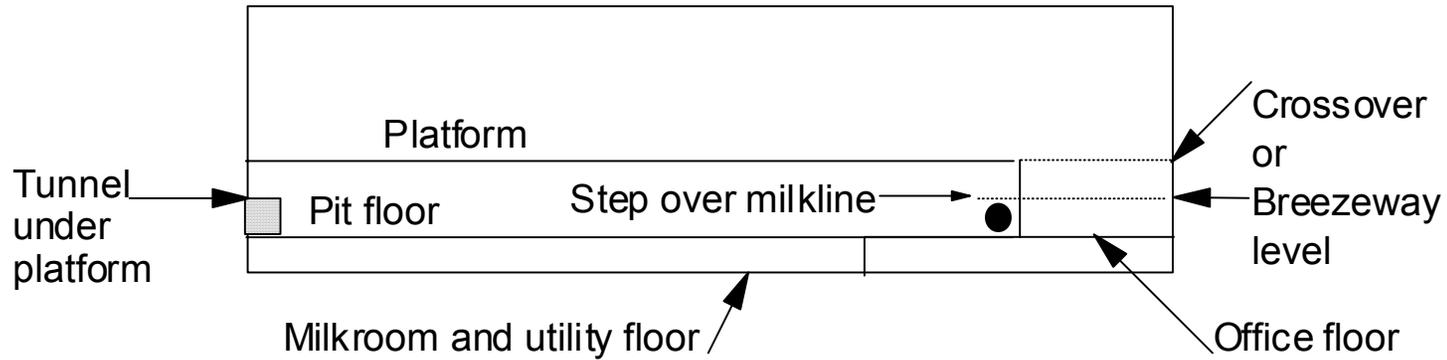
Can be initially installed with standard exit stalls, cow crossover, and single return lane in holding area. Build so that crossover can be removed to add extra stalls, rapid exit, dual return and dual cow catch facilities in future.

- The Wisconsin Idea Parlor
- Designed for the expanding herd in the upper midwest
- Milking system designed for optimal milking and cleaning performance
- Building designed around the milking system
- Parlor designed for expansion
 - Keep investment in line with herd size and cash flow
 - Does not limit addition of future options



- Design Details: Milking System Layout
- Keep receiver, wash sink, bulk tank and vacuum pump close together to minimize pipe length and improve milking and cleaning performance.
- Regulator can be mounted at the sanitary trap for best regulation efficiency without regulator noise or receiver in the parlor.
- Vacuum pump is close to receiver to minimize length of main air line and frictional losses.
- Parlor can be expanded without moving receiver or milk room.
- Parlor can be started with and existing 2 inch highline as a swing-8 (allow for possibility to convert to lowline in future) and existing bulk tank and refrigeration system.
- Initial building cost \$50,000 - \$70,000
- Initial equipment cost
 - \$10,000 using existing milking equipment as a swing parlor and simple stalls
 - up to \$100,00 with new milking equipment, automation, stalls and milk storage equipment.

Side View looking from milk room toward parlor



End view looking toward holding area