SYMPOSIUM: DAIRY FARMS IN TRANSITION

Planning the Milking Center in Expanding Dairies

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ABSTRACT

This paper focuses on large dairies that want to expand and milk more cows through an existing parlor or by building a new parlor. The expansion process can be divided into the following three phases: 1) financial evaluation, 2) design, and 3) construction. A financial evaluation should be carried out first to determine the resources that are available for expanding the dairy operation. This phase is extremely important, considering that 68% of the dairies that expand have cash flow problems within the first 2 yr of operation. The next phase is to design the milking center, and options include expanding the present parlor or constructing a new parlor. The present parlor can be expanded by addition of stalls, but group size must also expand to maintain cow flow at the larger parlor size. Group size can often be increased by combining corrals or free-stall alleys. The third phase in the expansion is to determine the most efficient milking procedure during the construction or remodeling of the facilities.
(**Key words**: milking, parlor, expansion)

Abbreviation key: × = times per day (used with number).

INTRODUCTION

Dairy farm size is increasing in all regions of the US. In two of the largest dairy states, California and Wisconsin, mean herd size has increased 950 and 250%, respectively, since 1950 (6). Dairy herds of 500 cows are common in all areas of the US, and herds over 1500 cows are common in the West and Southeast. Many dairy operations are considering expansion of existing facilities or construction of new facilities to increase efficiency, profitability, or both.

In many dairy operations, the maximum herd size is determined by the daily capacity of the milking center or the amount of land that is available for manure disposal. A lack of appropriate acreage on which to apply manure nutrients is one of the largest hindrances to dairy herd expansion in many areas of the US. With state and federal environmental regulations continuously becoming stricter, this area of concern must be addressed seriously. The construction or the remodeling of a milking center is an important business decision that will have an impact on the volume and profitability of the dairy operation for many years. The milking center is the single most expensive facility in a dairy operation, and dairy owners or managers should plan expansion of the operation very carefully. Milking facilities should not be the factors limiting milk production (5). Milking parlor capacity needs to be determined for both present and future needs. If expansion is planned for the future, new facilities need to be designed with the flexibility to allow for further expansion.

This paper centers on the management of large dairies that want to milk more cows through an existing parlor or to construct a new parlor, as well as the phases of the expansion process itself: 1) financial evaluation, 2) design, and 3) construction.

FINANCIAL EVALUATION

It is extremely important that a producer conduct a financial evaluation to determine how realistic the expansion of the dairy operation would be. A study completed by Speicher et al. (15) indicated that 68% of expanded farms experienced cash flow problems for 2 yr, and 34% of those farms had serious cash flow problems (14). Results from a second study evaluating productivity in New York dairy farms from 1989 to 1992 indicated that farms that expanded 30% had the highest increases in debt per cow and operating expenses per cow. This group of dairies had the largest increase in net farm income, return on investment, and milk sold per worker (9).

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Producers who want to expand need to consider the amount of capital that is available for expansion, the return on the dairy expansion compared with use of equity for other investments, and the cash flow benefits from the expansion. Producers are typically required to contribute 30% of the expansion cost in some form of equity (F. M. Fountain, Security Pacific National Bank, 1991, personal correspondence). Producers should determine the current cost of production per hundredweight and the marginal revenue per cow as well as the income from the expanded herd to estimate the amount of debt the expanded herd might carry.

Careful planning of any milking parlor is fundamental to the production of efficient and economical dairy facilities. A number of factors can affect milking parlor performance, including the number of operators, use of detachers, operator routine, milking interval, construction, use of a wash pen, and premilking hygiene (1). The analysis of parlor capacity, capital cost, capital cost per cow, milk output per day, milk output per worker, labor cost per hundredweight, annual costs for capital and labor, and cow throughput should be considered to maximize utilization of the milking parlor (10). Consideration of various options can save time and problems later and can ensure that the new parlor will perform adequately in new or existing facilities.

During the financial evaluation of a project, the development of a preliminary design is necessary to estimate the cost and performance of the expansion. This preliminary design would not have all of the information contained in a final design, but should be of sufficient detail to allow preliminary construction estimates and to show the lending institution that the facility is properly designed.

All options concerning the milking center should be considered, including the remodeling of an existing parlor, the construction of a new parlor, the use of multiple parlors, or the addition of a hospital barn to increase cow numbers. Recent research at the University of Florida (8, 15, 17) focused on the integration of production and economic variables to determine more profitable management strategies, including decisions about the milking parlor. Florida workers used a validated milking parlor simulation model to carry out a stochastic economic analysis to evaluate the effects of parlor size, parlor design, and operation of the milking center on parlor investment value. Stochastic dominance techniques ranked parlor investment alternatives, and the results indicated that parallel parlors were dominant over herringbone parlors and that two smaller parlors were dominant over one large parlor. Analysis of the dominant parlors indicated that investment values were higher when parlors were operated at 50.8-kPa vacuum and a 70:30 pulsation than at 46.6-kPa vacuum and a 40:60 pulsation (16). It also was found to be more profitable to build two double-20 parallel parlors than one double-40 parallel parlor. Net parlor returns for 15 yr were $4,445,625 for two double-20 parallel parlors and $3,536,686 for one double-40 parallel parlor. However, the initial construction cost was $22,227 more to construct two parlors. The effects of milking frequency, milk production level, and premilking hygiene also were examined in this study. Cow throughput per hour decreased by 10 to 12% when cows were milked 2 times per day (×) versus 3×. Total labor cost and parlor fixed costs were unaffected by milking interval. Gross income was higher when cows produced more milk and were milked 2×. When the rolling herd average for herds milked 2× was increased from 9979 to 11,340 kg, the number of cows milked per hour decreased by 2.5%. Using a minimal premilking hygiene routine versus a full premilking routine increased throughput by 21 to 39% and increased net parlor return (16). Producers also should evaluate how labor cost and milk output per worker will be affected by the expansion (10). Cash flow problems that occur during the first 2 yr have been caused by the cost of purchasing additional cows, the cost of raising replacements with no income, and a lower milk production per cow because of the higher percentage of first lactation cows in the herd. The profitability over a 15-yr planning horizon must be considered carefully. Budgeting for low incomes from milk and beef and high expenses for labor and feed helps to avoid serious problems with cash flow.

DESIGNING THE MILKING CENTER

Performance of milking parlors has been evaluated by time and motion studies to measure steady-state throughput (4). Steady-state throughput does not include the time for cleaning the milking system, maintenance of equipment, effects of group changing, and milking the hospital string.

The performance of various types of milking parlors in the US has been published by Armstrong et al. (2) and ranged from 25 to 401 cows per hour. Throughput in parallel parlors ranged from 84 to 401 cows per hour and from 60 to 205 cows per hour in herringbone parlors (2). Milking parlor performance within a parlor type or size may vary due to milking frequency, use of detachers, use of wash pens, premilking hygiene, number of operators, and operator routine. Whether the milking facility has been remodeled or is new construction also can affect

parlor performance. Data collected in parallel milking parlors indicated that milking cows 3× versus 2× increased throughput by 8 to 10%. The use of detachers did not increase throughput with the same number of operators. Use of a wash pen increased throughput by 8 to 20%. The use of predip milking hygiene reduced parlor performance by 15 to 20%. The average number of cows milked per man-hour decreased as the number of operators increased from 1 to 4 (1). If operators used a batch or territorial milking routine, throughput could be reduced by 20 to 30%. Steady-state throughput was 10 to 12% higher in new parlors than in renovated parlors (2). Parlor performance also may be affected by future increased milk production per cow (15).

Milking parlor size should be large enough to allow management personnel the flexibility to incorporate premilking hygiene routines. Milking parlors should be sized to incorporate different milking frequencies so that all cows can be milked once in 8 h when milking 2×, 6.5 h when milking 3×, and 5 h when milking 4× (3). Using these criteria, the milking parlor should be sized to accommodate cleaning and maintenance. Milking parlor operators often are put into situations in which the management goals are very difficult to attain. Many times, the limiting factor is the size of the milking parlor.

Many owners and managers prefer to use the design-build concept, or a design team, as described by Welchert et al. (18) and Brugger et al. (7). These concepts specify that dairy managers employ a dairy design consultant to develop a basic design and program plan to meet the needs of their clients. The design team consists of an agricultural engineer and supporting dairy management specialists, which might include dairy extension faculty, nutritionists, milking equipment manufacturers, and veterinarians. This team approach is an efficient way to integrate desired management into physical facilities.

Milking parlors need to be designed so that one group can be milked in 30 to 60 min, depending on milking frequency. Observations on commercial dairy farms indicate that a group of cows should be milked in 60 min when milking 2×, 45 min when milking 3×, and 30 min when milking 4× to minimize the time that cows stand on concrete, to minimize the number of cows being kept away from feed, and to ensure comfortable housing. Group size should be divisible by the number of stalls on one side of the milking parlor to maximize parlor efficiency by having as many stalls as possible per cycle. Each stall in the milking parlor can be used over 4.3 to 4.5 times per hour with 2× milking and 4.8 to 4.9 times per hour with 3× milking (2). Observations on commercial dairies indicate that the parlor can be turned over 6 times per hour with 4× milking. Because of the effect that milking interval has on group size, the desired milking interval should be determined early in the process.

Holding pens, drip pens, and wash pens should be designed for 1.39 m^2 per cow. Holding pens should be designed to hold one group of cows and typically have a 3% slope away from the parlor. If a drip pen is going to be used in conjunction with a wash pen, each pen should be sized to hold one group of cows. Return lanes should be shielded from the wash pen to prevent washing postdip from the cows exiting the milking parlor. Grids for the cow wash system should be spaced at 1.52 × 1.52 m or 1.52 × 1.83 m.

The width of the exit lane is dependent on the number of stalls on one side of the milking parlor. In parlors with 15 stalls or fewer per side, a clear width of 0.91 m is acceptable. For parlors containing more than 15 stalls per side, a clear exit lane width of 1.52 to 1.83 m is desired.

Operator pits are typically 2.44 m wide between curbs. The cow platform is 0.96 to 1.01 m above the floor of the operator pit. Provisions should be made to allow for floor mat thickness, if mats are to be used. The curb of the cow platform typically overhangs the operator pit wall by 22.9 cm. Normally, the operator pit and cow platform should have a 1% slope to the rear of the milking parlor, but, in some situations, a slope to the front of the parlor would be more appropriate. Operator pits typically have a 5-cm side slope from the center of the pit to the pit walls.

When the shell of the milking parlor is constructed, there are several options. If no future expansion is planned, the building can be constructed with no room for expansion, which often is done when the existing acreage is not sufficient for expansion. When long-term plans include expansion, the shell can be constructed with room to add a second parlor or add stalls. If a second parlor is to be added at a later date, the two parlors usually would share a common facility for equipment and milk storage. The additional space that is needed for expansion should be left in the front of the parlor to reduce cow entry time. Holding pens, wash pens, drip pens, and number of cows per group should be sized for the total number of cows that will be milked after the expansion. The building should be ventilated properly to maintain the comfort of employees and cows (13, 14). An office, meeting room, break room, and rest room facilities should be incorporated to meet the needs of management.

Figures 1, 2, and 3 demonstrate different options for constructing new milking centers that allow for future expansion. In Figure 1, a shell is constructed to

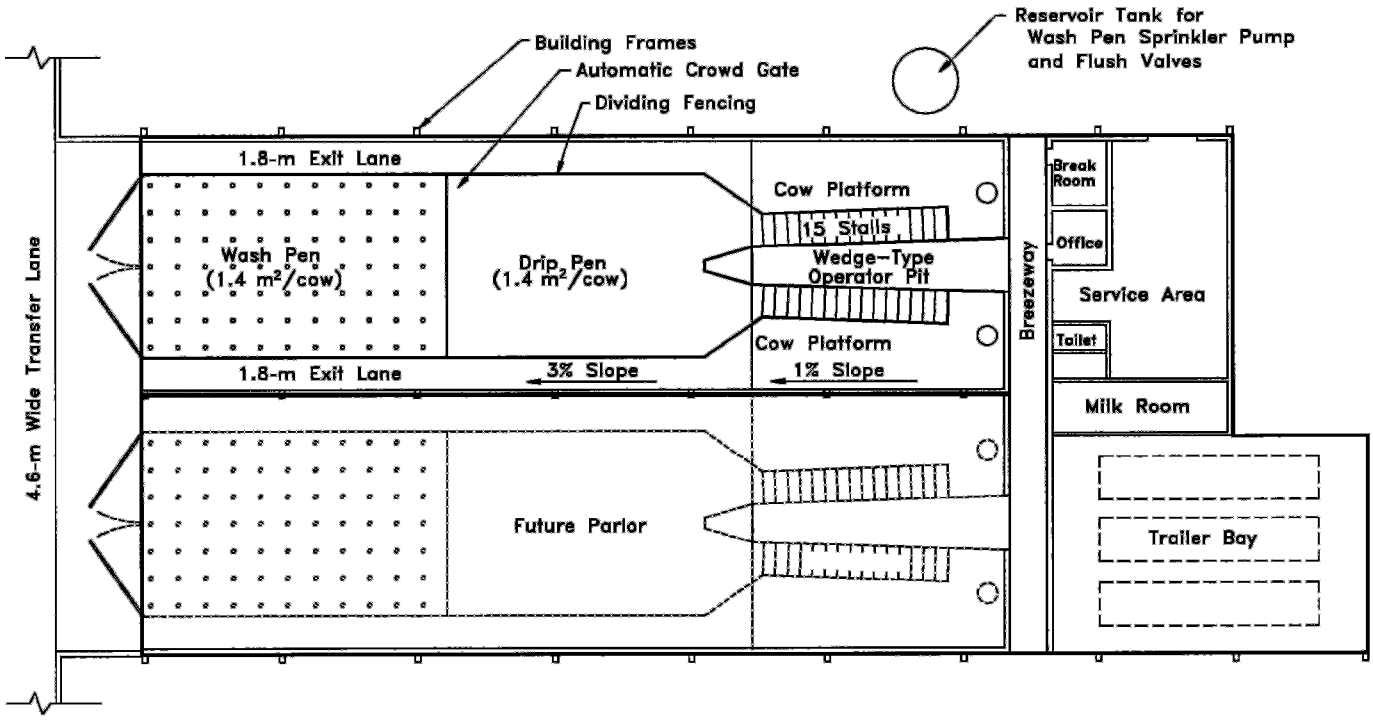

Figure 1. Double-15 parlor with room to construct a second double-15 parlor and a common service area.

allow two double-15 parlors to be constructed side by side with a common service area. In this situation, one parlor could be constructed initially, followed by a second parlor as the dairy expands. The disadvantage of this configuration is that the shell for both parlors is constructed at the same time. Figure 2 is an example of how a parlor might be constructed to add additional milking stalls as the dairy expands. When this scenario is used, establishing expansion goals at the initiation of the project is important to allow adequate space for additional stalls. Figure 3 demonstrates how a milking center could be constructed to

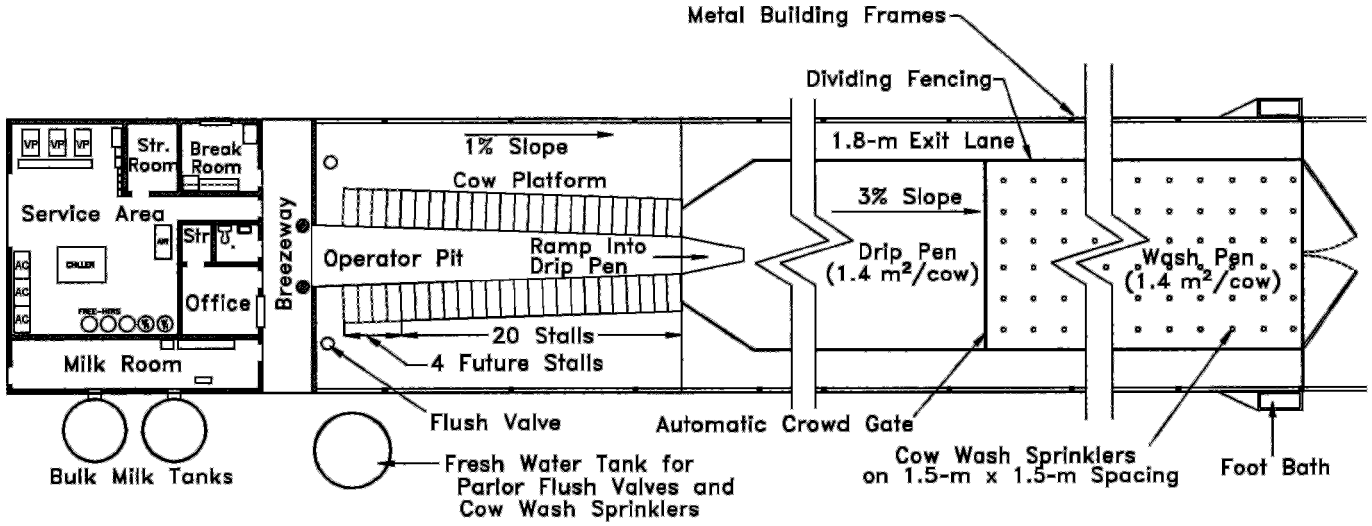

Figure 2. A double-20 parlor that is expandable to a double-24 parlor.

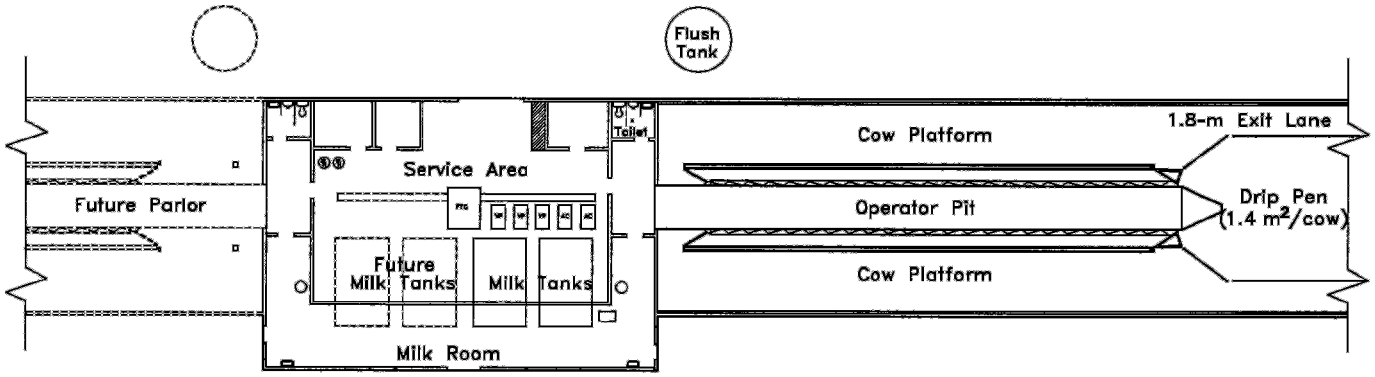

Figure 3. A double-24 parlor with room to construct a second parlor end to end.

add a second parlor onto the service area when additional capacity is needed. The end result would be to have two milking parlors end to end with a common service area in the middle. The advantage of arranging parlors this way is that the shell for the second parlor does not have to be constructed until it is needed. Table 1 shows the estimated parallel parlor and free-stall housing sizes for double-12 through double-40 parallel milking parlors.

Another option for expansion is to renovate an existing milking parlor, provided that enough acreage is available for additional pens and waste manage-

TABLE 1. Estimated sizes for parallel parlors and free stalls.[1]

			Length					Area	
Stalls per side	Cows per group	Total cows	Wash pen	Drip pen	Platform	Service	Total building	Total building	Free stall
	no.				(m)			(m/2)	
40	320	2560	13.9	13.9	79.2	15.2	37.3	500	22,605
39	312	2496	13.6	13.6	77.3	15.2	36.5	489	22,040
38	304	2432	13.2	13.2	75.4	15.2	35.7	478	21,475
37	296	2368	12.9	12.9	73.4	15.2	34.9	468	20,909
36	288	2304	12.5	12.5	71.5	15.2	34.1	457	20,344
35	280	2240	12.2	12.2	69.6	15.2	33.3	446	19,779
34	272	2176	11.8	11.8	67.6	15.2	32.5	435	19,214
33	264	2112	11.5	11.5	65.7	15.2	31.7	425	18,649
32	256	2048	11.1	11.1	63.8	15.2	30.9	414	18,084
31	248	1984	10.8	10.8	61.8	15.2	30.1	403	17,519
30	240	1920	10.4	10.4	59.9	12.2	28.3	380	16,954
29	232	1856	10.1	10.1	58.0	12.2	27.5	369	16,388
28	224	1792	9.7	9.7	56.0	12.2	26.7	358	15,823
27	216	1728	9.4	9.4	54.1	12.2	25.9	348	15,258
26	208	1664	9.0	9.0	52.2	12.2	25.1	337	14,693
25	200	1600	8.7	8.7	50.2	12.2	24.3	326	14,128
24	192	1536	8.3	8.3	48.3	12.2	23.5	315	13,563
23	184	1472	8.0	8.0	46.3	12.2	22.7	305	12,998
22	176	1408	7.6	7.6	44.4	12.2	21.9	294	12,433
21	168	1344	7.3	7.3	42.5	12.2	21.1	283	11,868
20	160	1280	6.9	6.9	40.5	12.2	20.3	272	11,302
19	152	1216	6.6	6.6	38.6	12.2	19.5	262	10,737
18	144	1152	6.3	6.3	36.7	12.2	18.7	251	10,172
17	136	1088	5.9	5.9	34.7	12.2	17.9	240	9607
16	128	1024	5.6	5.6	32.8	12.2	17.1	229	9042
15	120	960	5.2	5.2	30.9	12.2	16.3	219	8477
14	112	896	4.9	4.9	28.9	12.5	15.6	209	7912
13	104	832	4.5	4.5	27.0	12.8	14.9	200	7347
12	96	768	4.2	4.2	25.1	13.1	14.2	190	6781

[1]Sizes: 13.4-m overall milking parlor width, 1.83-m exit lane width for each side of the milking parlor exit, 1.39-m^2 density of the wash pen per cow, 1.39-m^2 density of the drip pen per cow, 76.2 cm per milking stall, 5.0 desired turns per hour per stall, 48 min of total holding time in parlor, 6.4 h of total milking time per shift, 8.83 m^2 of free-stall area per cow, and three times daily milking frequency.

ment needs. If an existing milking parlor is to be updated to include these activities, appropriate measures must be taken to ensure that the waste management system will be able to handle any expected increase in waste water flows. Storage ponds must be evaluated to guarantee that the proper waste water storage time will be supplied. Finally, crop acreage must be evaluated to determine that the increased amount of manure nutrients will be taken up by the crops planted.

Often, a herringbone parlor is converted to a parallel or parbone parlor to increase the number of stalls without increasing building size. The distance between the front of the stalls to the wall of the parlor should be a minimum of 1.83 m to take advantage of rapid exit stalls. Exit lane width is often too narrow, slowing down cow exit from the parlor. The holding, wash, or drip pen usually needs to be expanded when a parlor is remodeled. The refrigeration system and milk storage area may need to be increased to compensate for additional milk production. The vacuum system also may need to be upgraded (11).

After the design of expanded facilities is complete, the financial position of the dairy after inclusion of the estimated debt load should be reevaluated. Overall cow numbers, production goals, or debt structure may need to be modified.

CONSTRUCTION

Construction of a new facility or remodeling of an existing facility is a time-consuming process. In general, a minimum of 4 to 6 mo are needed to construct a new facility. Because managers want to generate income as soon as possible, cows are often ready to calve before the milking center is complete. Adequate time should be allowed for the construction delays that may arise from weather and other uncontrollable variables.

Dairy producers who are remodeling an existing barn need to consider how cows will be milked during the renovation. Options include leasing an alternative facility, constructing temporary facilities, moving cows to another dairy during the construction, or remodeling one side of the parlor while milking cows on the other. Everything possible should be done to minimize stress on the cows during this process to prevent losses in milk production.

CONCLUSIONS

The construction of a new milking center or the remodeling of existing milking parlors is a very important decision that can dramatically affect the labor efficiency and profitability of a dairy. Dairy producers should set reasonable goals for present and future needs. All options and configurations of the milking center should be considered and evaluated on a 15-yr planning horizon. Milking parlors should be designed to allow use of a full milking hygiene and flexibility in management. Employing a design team is useful to incorporate management needs into a workable facility with minimal financial risk.

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