



BEEF FEEDLOT SYSTEMS MANUAL



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IOWA STATE UNIVERSITY
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Iowa Beef Center

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Beef Feedlot Systems Manual



Introduction

Iowa's cattle feeding industry is important to Iowa's state and local economy. More importantly, it is a significant enterprise on several thousand Iowa farms. Cattle feeding: 1) adds value to corn and forages; 2) more fully utilizes farm resources such as labor, facilities, and machinery; and 3) provides profit opportunities for skilled managers. Iowa producers are reinvesting in feedlots to modernize, improve environmental performance, and capture emerging opportunities through expansion. The regional distribution of the U.S. cow herd is slowly moving to the north and is creating opportunities for Corn Belt cattle feeders. A significant period of growth in retail beef demand has reinforced economic viability in growing the cow herd and the feedlot industry.

The 2012 Census of Agriculture reported Iowa has 6,036 feedlots. Compared to 2007, the total number of feedlots has declined by almost 32%, primarily due to the attrition of feedlots with less than 200 head. However, the nearly 4,000 feedlots with less than 200 head that still exist comprise 65% of the total number of Iowa cattle feedlots. There has been expansion in the number of feedlots housing 200-500 head and in feedlots with greater than 5,000 head. While the total number of Iowa feedlots has declined and there are fewer cattle on feed, the value of cattle being fed in Iowa has increased. The number of finished cattle marketed from Iowa feedlots declined by 13.3% between 2007 and 2012. At the same time, animal weights and value per pound increased by 3.4% and 33.7%

respectively. From these numbers the estimated receipts for Iowa-fed cattle increased by nearly 20% from 2007 to 2012.

Iowa is the leading state in ethanol production, which has important implications for Iowa's cattle feeding sector. Each bushel of corn converted to ethanol produces approximately 17 pounds (air dry basis) of distillers grains and solubles (DGS), a high quality feedstuff for cattle. DGS works particularly well in feedlot rations and has a higher feed value wet compared to dry, resulting in a win-win situation for ethanol plants and nearby cattle feeders. Inclusion rates of DGS ranging from 20%-40% or more of the dry matter in the ration can significantly reduce cost of gain for feedlots.

Demand for high quality beef has continued to fuel valuebased marketing systems that reward Iowans for the type of cattle they produce. As a result, innovative marketing programs and alliances have emerged, providing Iowa feeders with more choices as to where and how to sell their cattle. Value-based marketing, or grid marketing, rewards producers who market cattle with characteristics the market desires.

Iowa has been gaining market share in cattle feeding, by increasing feedlot inventories from 9.2% of the U.S. total in 2012 to 9.7% in 2014 (USDA NASS, 2014) This represents a 5% increase in Iowa's share of the nation's feedlot inventory over a 2-year period.

In 2014, Iowa State University's College of Agriculture and Life Sciences revised the document, "[A Vision for Iowa Animal Agriculture](http://www.ans.iastate.edu/dept/2013VisionofAnimalAgriculture.pdf)" (http://www.ans.iastate.edu/dept/2013VisionofAnimalAgriculture.pdf). This visioning exercise is conducted periodically to evaluate the current status of Iowa animal agriculture and opportunities for growth. The document sets a goal of increasing Iowa's market share of U.S. cattle feeding by 1.5% and increasing receipts and economic activity by 20% by 2022. Currently the industry is well ahead of the pace to achieve this goal.

At the same time the cattle feeding sector is experiencing growth, there is increasing scrutiny of agricultural environmental practices in general, and in particular, potential water quality concerns and managing effluent from open feedlots. In response to concerns raised by citizens and organized groups about ground and surface water quality, regulatory agencies such as the Environmental Protection Agency and the Iowa Department of Natural Resources, have increased enforcement of existing laws. All animal feeding operations, regardless of design or size, should implement practices and designs to prevent discharges and utilize manure nutrients effectively.

Feedlots considering expansion or new construction must be aware of three primary areas: 1) the environmental regulations; 2) how the facility design impacts potential water quality and regulatory issues; and 3) the resulting cost to the feedlot and the environment. This publication describes and evaluates alternative feedlot designs in terms of investment, operating cost, labor requirements, potential manure nutrient utilization and value, and animal performance relative to cost of gain. The designs incorporate appropriate environmental control features. Economic analysis incorporates differences in animal performance, initial investment costs, annual operating cost, and cost of gain.

As with any modeling analysis, the results depend heavily on the assumptions. These assumptions and the reasoning behind them will be explained. Also note that this analysis is based on new construction of the feeding facility. It does include an estimate of overhead items such as feed storage, cattle handling facilities, and feeding equipment. Existing feedlots may already have made these investments. The analysis assumes a level of management that meets the stated performance goals.

As producers evaluate alternative facility designs, they must keep in mind the following needs:

- Create an environment to assure cattle comfort and achieve the target performance
- Protect water quality and be neighbor friendly
- Recognize that site-specific factors, such as soil type, rainfall, slope, and drainage affect the choice of facility design
- Facilitate and encourage proper observation, movement, and management of cattle to assure optimal cattle performance and worker safety
- Consider the cost-benefit of alternative facility designs
- Remember that a variety of facility designs can meet these objectives



Iowa Cattle Feeding Economics

Iowa has several cattle feeding advantages. The most obvious is the availability and price of corn and corn processing coproducts. According to USDA's Agriculture Marketing Service (AMS), during the period 2004-2013, Iowa corn prices were significantly less than other regions. The prices ranged from \$0.12 per bushel less than southwest Nebraska and \$0.43 per bushel less than parts of the Texas cattle feeding region.

One concern often raised about feeding cattle in Iowa is that of competition for fed cattle from packers relative to other regions. During the same 2004-2013 period, Iowa fed cattle prices were similar to those received in Nebraska, and exceeded other regional prices on a shrink adjusted live price (Table 1).

It is often thought that much of the corn price advantage is given back in poorer performance related to Iowa's weather. However, feedlot closeout analysis indicates that Midwest feedlots have comparable performance, superior quality grade, and a cost of gain advantage over the Central and High Plains (Table 2). Midwest feedlots tend to use more feed per pound of gain and have more Yield Grade 4 and 5 and heavy carcasses. To achieve this level of performance, feedlots must be well designed and managed.



Table 1. Average live steer prices, 2004-2013 for Iowa and leading feedlot states

	Texas	Colorado	Kansas	Nebraska	Iowa
Shrink (%)	4%	4%	4%	3%	3%
Average price (\$/cwt)	\$ 94.58	\$ 94.55	\$ 98.61	\$ 98.39	\$ 98.16
Shrink adjusted live price (\$/cwt)	\$ 90.80	\$ 90.77	\$ 94.67	\$ 95.44	\$ 95.21

Table 2. Regional benchmark steer data, 2009-2013

	ADG	F/G	COG	VM	PR+CAB	Choice	Outs
Region	lbs.	ratio	\$/lbs.	\$/head	%	%	%
Central Plains	3.46	6.18	0.96	16.55	13.89	53.82	15.36
High Plains	3.26	6.25	0.99	14.48	10.84	49.77	15.42
Midwest	3.41	7.02	0.90	17.45	14.56	63.22	22.64
North Plains	3.45	6.49	0.93	17.40	20.85	62.11	16.71

Source: Vet Life, Benchmark, Outs include YG 4 and 5 and Heavy and Light Carcasses.



Beef Cattle Feedlot Facilities Descriptions

There is a wide range of feedlot facility types in the state. A [2014 Iowa Beef Center survey](https://store.extension.iastate.edu/Product/Iowa-Beef-Center-2014-Feedlot-Operator-Survey) of beef feedlot operations in Iowa (<https://store.extension.iastate.edu/Product/Iowa-Beef-Center-2014-Feedlot-Operator-Survey>) revealed that of cattle finished in Iowa, 51% were in open lots with shelter, 27% in lots without shelter, 19% in bedded confinement, and 4% in deep pit confinement buildings. The survey also showed that of operations that expanded in the last five years approximately 25% expanded with open lots without shelter, 25% expanded with open lots with shelter, and 50% used confinement.

This publication focuses on the four similar design options that were identified in the survey: 1) open lot with windbreak; 2) open lot with shed; 3) deep-bedded confinement; and 4) slatted floor confinement. Within each of these systems, design and layout can vary greatly. There are other design options that combine these features that have been built in the Midwest but detailed descriptions and costs are not included in this publication.

Following are general design images and descriptions that provide an overview of the types of facilities listed above. For specific design options, use the following Midwest Plan Service resources and work with an experienced contractor to customize designs to fit a particular situation.

[MWPS 6 Beef Housing and Equipment Handbook](https://www-mwps.sws.iastate.edu/catalog/livestock-categories/beef-operations/beef-housing-and-equipment-handbook)

<https://www-mwps.sws.iastate.edu/catalog/livestock-categories/beef-operations/beef-housing-and-equipment-handbook>

[AED 60 Cattle Feeding Buildings in the Midwest](https://www-mwps.sws.iastate.edu/catalog/construction/cattle-feeding-monoslope-and-gable-roof-buildings-pdf)

<https://www-mwps.sws.iastate.edu/catalog/construction/cattle-feeding-monoslope-and-gable-roof-buildings-pdf>

[AED 50 Hoop Barns for Beef Cattle](https://www-mwps.sws.iastate.edu/catalog/livestock-categories/beef-operations/hoop-barns-beef-cattle-pdf)

<https://www-mwps.sws.iastate.edu/catalog/livestock-categories/beef-operations/hoop-barns-beef-cattle-pdf>

Each of the four feedlot systems has different investment costs that will be detailed in this manual. Assumptions for each of the four systems include the following:

- Based on 500 head capacity
- One foot of bunk space per head is allowed. In practice some layouts provide less space, but Midwest Plan Service recommends 11-13 inches of feeder space for twice-a-day feeding.
- Open lots have 20-foot wide concrete aprons adjacent to fence line feed bunks
- Environmental controls are in place to meet or exceed regulations and prevent discharges
- Animals are allotted the following minimum square feet per head:
 - Open earthen lot with windbreak or with shed – 150
 - Open concrete lot – 60
 - Open concrete lot with shed – 70
 - Deep-bedded confinement – 40
 - Slatted floor confinement – 23



Open Lot with Windbreak

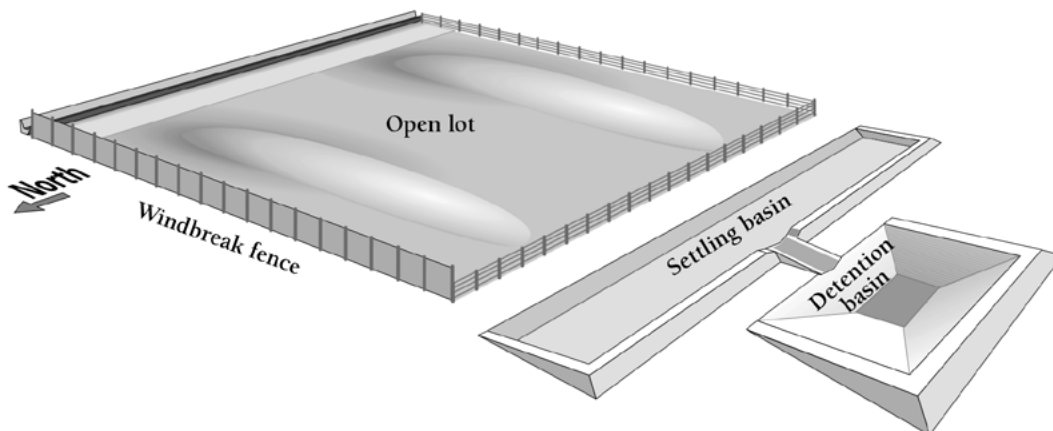
In the open lot system (Figure 1), cattle are fed in an open lot with no shed. An 8-foot to 12-foot high windbreak fence or trees on the north and west will provide protection against prevailing winds in colder months. The surface of the open lot may be earthen or concrete. Permanent fencing surrounds the lot, and a gravel/rock drive is adjacent to a fence line feed bunk.

In an open earthen lot with windbreak, each animal is allotted the minimum of 150 square feet of space. Typical designs are 20 feet of concrete adjacent to the bunk and then 120 feet of earthen surface from the concrete to the back fence. Assuming 16-foot wide gates within the bunk line, this layout provides approximately 22 square feet of concrete and 132 square feet of earthen surface per animal.

Forty square feet per head of mound space is included within the earthen surface as dry resting space in periods of wet, muddy conditions.

Although a concrete lot surface is more expensive than an open earthen lot, less labor is involved in maintaining the feedlot surface, and less land area is involved in the facility. In open lots with a concrete surface, 60 square feet per head is allowed. Some open concrete lots are designed with a concrete mound in the center of the pen, which usually is bedded to provide animal comfort. There is no research on cattle performance in concrete lots compared to earthen lots, so open concrete lot performance is assumed to be the same as open earthen lot. A detailed cost analysis for the concrete open lot is not provided, but initial investment for the concrete lot is approximately \$190 per head more than the earthen lot.

Figure 1. Open earthen lot





Open Lot with Shed

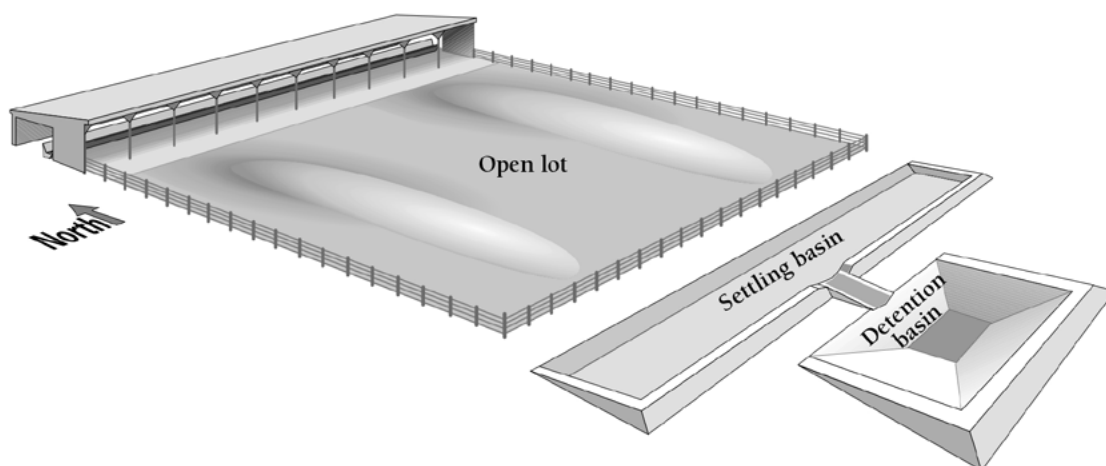
The open lot with shed system involves a shed and either an earthen (Figure 2) or concrete open lot (Figure 3). If the open lot surface is earthen, usually the shed provides approximately 25 square feet per head, and the earthen outside lot provides an additional 125 square feet per head. The shed is a 42-foot wide post frame, uninsulated structure with a concrete floor that extends 12 feet outside the building roof on the south side. It is open on the feedlot side with a curtain on the back to provide ventilation. Gutters keep roof water out of the feedlot.

In this design the feed bunk is located inside the building, with a 16-foot wide feed alley under roof that can be used to sort and move cattle. Mounds are included in the open part of the pen and sized to provide 40 square feet per head. Water diversion and manure management are similar to the open lot with windbreak.

If the open lot with shed has a concrete surface, the total square footage per animal is reduced. This system utilizes a shed that provides 20 square feet per head inside with an outside paved lot providing an additional 50 square feet. The shed is a 36-foot wide post frame, uninsulated building with a concrete floor. It is open on the feedlot side, has a ventilation curtain on the back side, rain gutters and an inside feed alley – similar to the earthen lot with shed.

Because cattle density in the concrete lot with shed is greater than in the earthen lot with shed, pens are scraped more often, usually weekly. A concrete settling alley below the pens serves two purposes – to settle the solids from pen runoff and to aid in sorting and handling cattle. Water diversion, environmental regulations, and manure management are similar to the open lot with windbreak.

Figure 2. Open earthen lot with shed



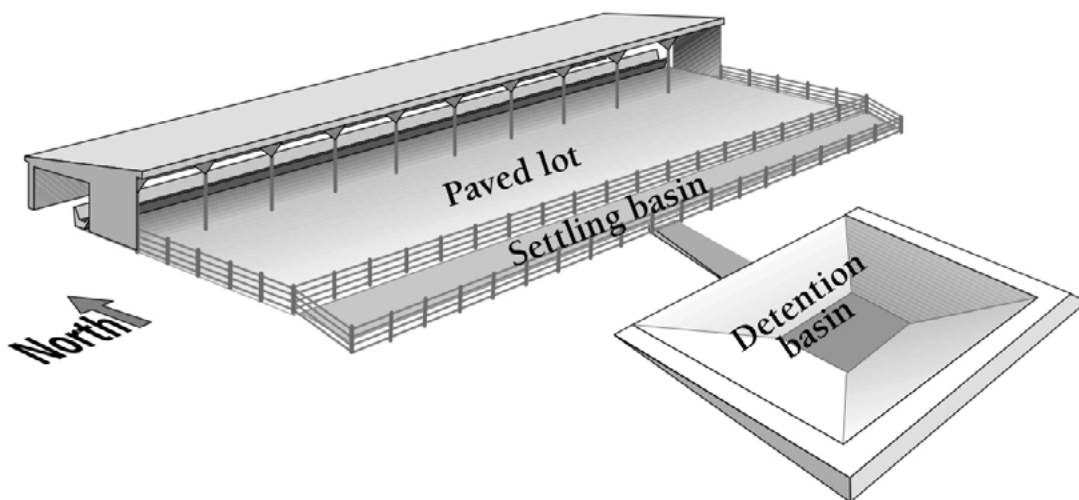


For all open lot designs, a location with enough room to allow for runoff controls and still provides adequate drainage from the surface is needed. This is estimated to be 20% of the pen space area, which is included in the total land area needed for the lot layout.

The type of control system and design features may alter the space needed. Diversions on the upper side of the open feedlot are designed to direct clean water away from the lot, thereby reducing the volume of runoff to be handled. For all sizes of open lots, solids settling is required. It is recommended that storage and pumping be used to manage the effluent and prevent a discharge to United

States waters. For operations not needing a National Pollutant Discharge Elimination System (NPDES) permit the controls might not need a professional engineering design. For an open earthen lot or combined confinement and open lot of 1,000 head or more, an NPDES permit is required if the operation discharges to a water of the United States. The NPDES permit requires environmental controls designed by a professional engineer to contain and land-apply effluent runoff from anything less than a 25-year, 24-hour rainfall event. Open lot operations with less than 1,000 head may be required or may choose to obtain an NPDES permit, depending on the situation.

Figure 3. Open concrete lot with shed





Deep-Bedded Confinement

Deep-bedded facilities typically are totally-roofed confinement structures with partial or total solid concrete flooring. Natural ventilation is used in all these facilities. High roofs increase the air space and allow warm, moist air to rise and escape from the building.

Although in practice, square footage per animal varies greatly in these facilities, a minimum of 40 square feet per head is recommended. Next to the bunk is a concrete bunk apron and the remainder of the floor space is concrete or packed earth covered with crushed limestone or other material to provide a solid base for bedding.

Deep-bedded facilities usually are one of three general types based upon the roof type – monoslope barns, gable roof barns or fabric-roofed hoop structures.

Monoslope barns are of two designs – wide (Figure 4) and narrow (Figure 5). Wide monoslope barns are typically 100 feet wide; narrow monoslopes are usually 40 feet to 60 feet wide. The south roof height is determined by the width of

the building. A slope of at least 1.5:12 (1.5-foot rise to 12-foot run) for a monoslope and at least 10-foot high clear sidewall openings are required for adequate ventilation.

Usually, monoslope barns are oriented east-west for two reasons. First, the high, open wall to the south and a ventilation curtain along the north wall provide natural ventilation, especially in the summer when the wind direction is predominantly from the south.

Figure 4. Wide deep-bedded confinement building with solid floor

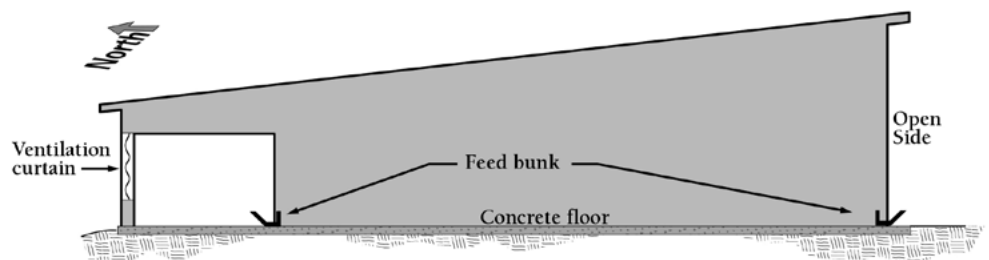
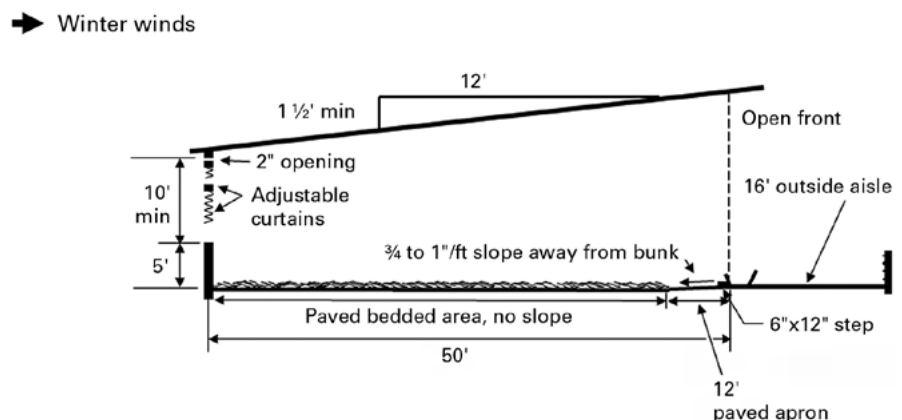


Figure 5. Narrow deep-bedded confinement building with solid floor



This orientation also allows the producer to minimize effect of northerly winds in the winter and keep precipitation out of the building by adjusting the size of the curtain opening. Second, the east-west orientation and the slope of the roof allow sunlight to reach the back of the pens in the winter, enhancing cattle comfort. In the summer when the sun is higher, the monoslope roof provides shade, thereby reducing solar radiation and heat stress.

Wide monoslope barns have two sets of fence line bunks. One bunk is filled from an alley inside the north wall of the building; the other bunk is filled from an alley located outside the south edge of the building.

In narrow monoslope barns, most of the buildings have only one feed alley, located on the south side. Some designs extend the roof beyond the pen space to help cover the bunk.

Because narrow monoslope barns have a fence line bunk on only one side, to accommodate an equivalent number of cattle, the length of the building is longer than a wide monoslope barn.

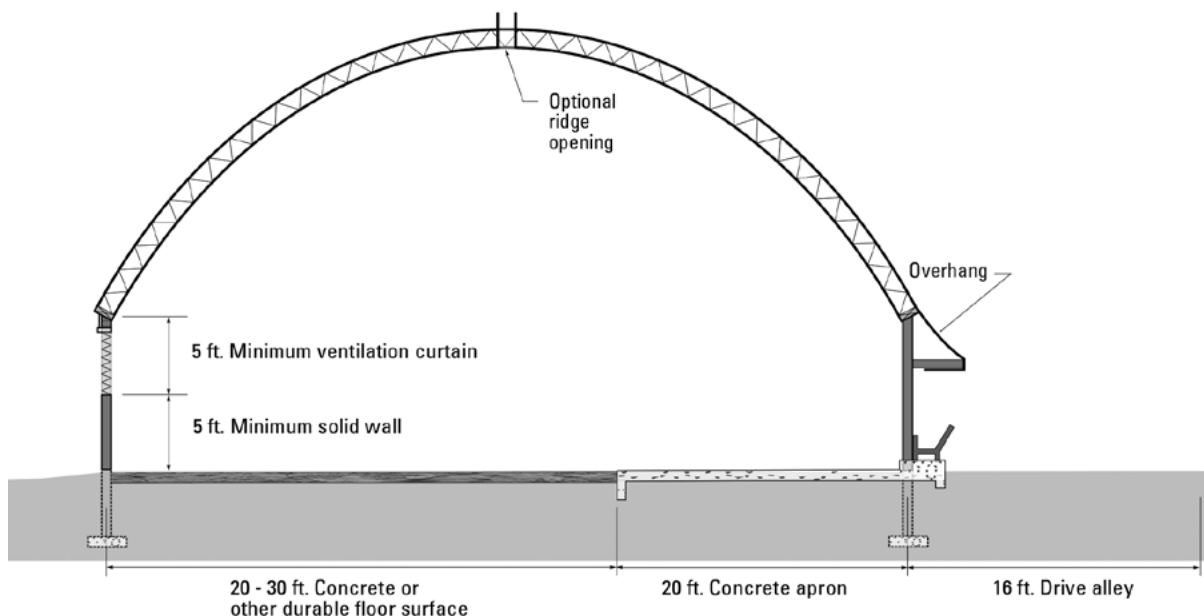
A deep-bedded facility with a gable roof is another design option. In this design, the barn is typically oriented lengthwise east-west, with feed alleys inside the building on both the north and south sides of the pens. Building widths are usually 90 to 100 feet. The south wall of the building has a 2-foot wall, with 5-foot fencing above this.

The area above the fence is open to the roof. The north wall has a 5-foot to 6-foot concrete wall, with a ventilation curtain above the wall that is raised or lowered to control wind flow through the building. There is a center ridge opening in the gable roof that provides an opening for warm air to rise and escape from the building. The size of the ridge opening is proportional to building width; a minimum of 2 inches for every 10 feet of building width.

Another popular deep-bedded design is the hoop building (Figure 6) or buildings that have a tarped roof instead of a metal roof. These types of roofs can be supported by an arched frame or hoop, or a more traditional gable style roof frame. Typically, these buildings are oriented east-west. Usually, bunks are along the south or east side of the building and covered by a tarp extension or eave. The feed alley is most often on the outside of the structure but the bunk is usually covered by an eave added to the edge of the roof. But in some wider hoop buildings, the feed alley is inside the structure and covered by the roof.

Most hoop buildings are 40 feet to 60 feet wide with a 12-foot to 20-foot concrete bunk apron. The floor surface beyond the apron and to the back of the building may be crushed limestone or concrete. The back wall is usually 5 feet high and constructed from wood plank, concrete, or other sturdy material. Above the wall is a fabric curtain extending to the edge of the tarp. The curtain can be raised or lowered as needed to provide ventilation. The wall above the bunk is open to the roof tarp. End walls are usually a combination of a 5-foot high wall, with either wood or steel extending to the edge of tarp. The end wall

Figure 6. Deep-bedded confinement hoop building



There are two general methods of bedding and manure management in deep-bedded facilities. The pen is bedded once or twice weekly and the manure-bedding pack is allowed to accumulate. In a wider barn, this bed pack is in the middle of the pen; whereas, narrower barns usually have the bed pack area in the back of the pen. Wet manure along the bunk aprons and around the edge of the pack is normally scraped and removed once or twice weekly.

In the first method, the pack is removed with each turn of cattle in the pen. In the second method, the pack is removed every three to four weeks, which is commonly referred to as “shallow bedding.”

With both methods, bedding is usually chopped and blown onto the pack. Manure may be temporarily stored in specifically designed bays between two adjacent pens, at the ends of the barn, or stockpiled a distance from the facility until it can be land applied.

Slatted Floor Confinement

The slatted floor confinement system (Figure 7) has an 8-foot to 12-foot-deep concrete pit located below the concrete slatted pen surface for liquid manure storage. This pit size is designed to be pumped twice yearly. To increase pit capacity, some newer barns have extended the pit dimensions to include the area below the feed alley.

Another design option is the use of specially manufactured rubber mats over the concrete slats. The mats provide a cushion for the cattle that can enhance animal comfort and help alleviate feet and leg issues that are more common in cattle fed on concrete slats. The mats are designed with spaces to match the opening in the slats that allow manure to enter the pit. In this publication, the cost of rubber mats is included in the cost of the slatted floor confinement facilities. Research regarding the effect of rubber mats on feed efficiency and daily gain is limited. There is a trend toward improved performance, but results are inconsistent and have not had statistically significant differences in most studies. There does seem to be an improvement in cattle soundness when mats are used as compared to cattle housed on bare concrete slats without rubber mats.

Cattle fed in a slatted floor confinement system are confined within the building. Twenty-two square feet to 25 square feet is typically allowed per animal. The building is usually 40 feet to 60 feet wide, which accommodates manure agitation and pumping. There is a drive-through feed alley on the north side of the pens with a fence line bunk.

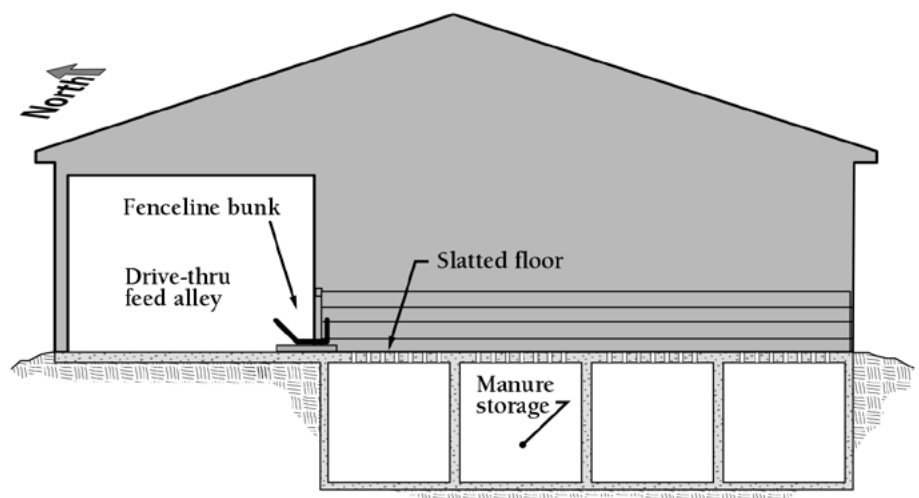


On the north side of the building is a 5-foot concrete wall.

A ventilation curtain extends from this wall to the edge of the roof. The south side of the building is normally open-sided. The roof may be one of several designs – monoslope, gable or hoop. With monoslope and hoop roof design the feed bunk may be on the south edge of the building with an outside feed alley.

For both bedded and slatted floor confinement facilities, no discharge from the facility is permitted by Iowa law. For operations of 1,000 head capacity or more, construction permits are needed and for those 500 head or more, a manure management plan is required. Other regulations on separation distances also apply.

Figure 7. Slatted floor confinement





Feedlot Performance and Facility Type

Facility design that improves animal comfort also may improve cattle performance. Weather-related influences can affect animal comfort and performance, but fortunately beef cattle can perform fairly well in a wide variety of weather conditions.

In Iowa, the main weather-related influences are heat stress, cold stress, and mud. Heat stress is usually short term during summer months, and facilities that have good airflow and shade will likely improve comfort and animal performance. Cold stress occurs during winter periods, and in addition to cold temperatures, wind exposure and/or wet hair coats are causes of cold stress. Reducing wind and keeping cattle dry can reduce cold stress. Muddy conditions in earth lots increase the energy for maintenance and reduce the insulation property of hair coats. Reducing mud can enhance animal comfort and performance. Weather-related influences are hard to predict, and vary from year to year and from season to season. Management and facilities that offset these adverse weather-related stress conditions can improve performance when they occur, but without weather-related stress, there may be no difference in animal performance between facility types.

Long-term research that accounts for weather variation can help predict how facilities may impact performance. A considerable amount of research was conducted, primarily in the 1970s, evaluating cattle performance and facility type. More modern studies looking at deep-bedded housing systems from Iowa and South Dakota are summarized in Table 3. Not all building and facility types that exist in practice have been used in research trials to evaluate performance.

Although considerable variation exists in the studies, there appear to be consistent trends. In early studies feed intake was reduced in total confinement. However, recent research did not note this reduction.

Feed efficiency of cattle in open lots is improved when shelter is provided. Based on these studies, it is assumed that cattle fed in open lots with shelter and bunks located in the shelter would be 4% more efficient than cattle fed in open lots without shelter. It also was assumed that

Other Designs

A modified style of either the slatted floor confinement or solid floor bedded confinement is a structure that has a limited amount of open lot space outside that is not covered by a roof. Space allocated is much less than an open lot with shed – generally 10% of the entire pen space. With a slatted floor building, the outside lot area is sloped to drain to the pit to contain manure. In Iowa, a combination of roofed and unroofed pen space may affect confinement/open lot legal status.

Another option of a total confinement design is a building with partial pit and slats, and partial solid floor with bedding.

Cattle performance and cost analysis is not included for either of these combination facilities.

confinement cattle are 4% more efficient with similar feed intake to cattle fed in open lots. Average performance assumptions for calves and yearlings were based on recent closeouts from the Iowa State University Beef Feedlot Monitoring Program. The average performance was then adjusted for facility type based on the previously-stated assumptions.

Table 3. Feeding trial summaries - confinement and shelter effects on feed intake and feed efficiency

Feeding trials	% Change	
	Feed intake	Feed required per pound gain
Confinement vs. open lots without shelter		
Iowa State (Allee, 1970-75)	-7.90	-6.80
Iowa State (Allee, 1978-83)	-9.10	2.10
Minnesota (Morris, 1970-76)	-0.60	-4.50
Minnesota (Morris, 1977-78)	6.00	-5.10
Nebraska (1974-75)	-3.50	-1.00
Missouri (commercial feedlot, 1974-1982)	-12.00	-1.00
Iowa State (closeout summaries, 1987-88)	-6.00	-1.00
Land O' Lakes/Iowa State (deep-bedded, 2007-09)	none	-4.60
South Dakota (7 years data, deep-bedded, 2013)	none	-3.85
Shelter vs. no shelter in open lots		Feed required per pound gain
Iowa State (Allee, 1970-75)		-9.20
Iowa State (Allee, 1978-83)		-5.50
Minnesota (Morris, 1970-76)		-2.40
Minnesota (Morris, 1977-78)		-6.70
Henderson & Geasler, 13-study summary)		-5.00
Iowa State (Closeout summaries, 1988-97)		-3.00
South Dakota (7 years data, 2013)		-3.50

Seasonal data from the South Dakota project would indicate that cattle fed from a January to March time period accounted for most of the differences in performance between the open lots and open lot with shelter or confinement housing.

The performance assumptions for steer calves and yearlings for each of the facility types is shown in Table 4.

Table 4. Performance assumptions of yearling steers and steer calves fed in differing facility types

	Yearling steers		Steer calves	
	Open lots (no shelter)	Sheltered lots and confinement	Open lots (no shelter)	Sheltered lots and confinement
Average daily gain, pounds	3.47	3.61	3.27	3.40
Feed/gain, dry matter	7.20	6.92	6.80	6.54
Dry matter intake, pounds	25.00	25.00	22.20	22.20
Days on feed	144	138	184	176

Feedstuffs used in feedlot rations are quite variable in Iowa. Many feeders harvest the majority of their feedstuffs from their own grain operations. To simplify feed costs, a corn/hay/distillers diet is used in this analysis and the total feed required is shown in Table 5.

The feed storage used could certainly vary by operation, but for this analysis feed storage is assumed to be a commodity shed with 12 foot wide by 36 foot deep concrete bays with monoslope roof for the main feedstuffs, and bulk bin for the supplement across all systems. One week of feed storage was assumed for the concentrates and two weeks of storage for ground hay. An estimated initial investment for feed storage is \$25 per head of capacity across all systems.

Table 5. Total feed for a yearling steer and steer calf fed in differing facility types

	Yearling steer		Steer calf	
	Open lots (no shed)	Open lots with shed and confinement	Open lots (no shed)	Open lots with shed and confinement
Corn (bushel)	47.30	45.46		46.91
Hay (ton)	0.202	0.195	0.3433	0.3301
Distillers grains (52% DM, ton)	0.866	0.832	0.9792	0.9417
Supplement (pounds)	95	91	129	124



Manure Nutrient Value and Environmental Stewardship

Rising commercial fertilizer costs in the past 15 years have renewed interest in the use of manure in crop production. A factor in profitability is how effectively the manure nutrients can be used to lower crop production costs. A goal of livestock operations should be to effectively use the manure nutrients to add value to the livestock operation.

Livestock operations that capture and utilize more manure nutrients have an advantage – provided the cost of capturing and utilizing the nutrients is less than the value. All operations must meet basic environmental regulations to protect water quality and prevent runoff. In addition to the regulatory requirements, additional management practices may facilitate improved capture and utilization of nutrients.

Nutrients in the manure start with the ration that is fed and the efficiency of the animal consuming the ration. When ration nutrients exceed requirements or the animal is less efficient in utilizing those nutrients, more nutrients are excreted.

Factors influencing the actual plant available nutrients following animal excretion are:

- Type of beef housing system
- Manure handling
- Manure storage
- Application management
- Environmental factors such as temperature, moisture, and wind speed

Types of Facilities and Manure Management

When comparing feedlot facilities, factors such as manure handling, nutrient value, regulatory compliance, and environmental stewardship need to be considered. Producers are making a basic choice on handling solid or liquid manure when they choose a facility type. Both liquid and solid manure have value but differ in manure handling equipment, cost, scheduling, and time required to clean, move, and manage manure.

Open feedlots typically have the lowest manure handling cost, but also the lowest nutrient capture and value. Manure on an open lot surface is affected by environmental factors that can lead to less total manure and less nutrients in the manure. Nitrogen can be lost as volatilized ammonia. Added rain and mud can dilute nutrients. Nutrient concentration is affected by frequency of scraping the lot. Frequent scraping captures more nutrients, but if land is not available for application, the manure must be stored. Manure nutrient concentration and moisture in open lot manure is highly variable, which makes it difficult to match land application rates to meet crop nutrient needs. However, there is value to open feedlot manure and it can be a valuable resource when managed properly.

Quantity of manure varies greatly in an open feedlot and is influenced by season. A yearly average estimate is three tons wet basis per head space. Manure nutrient value comparison should include the capture and use of the effluent or liquid that can be part of the runoff from open lots. Utilization of the effluent for crop production

can be challenging because it is typically low in nutrient concentration and the volume of effluent land applied usually requires pumping versus hauling.

Confinement buildings retain more nutrients because there is less environmental interaction. Manure nutrients and urine are captured in the bedding or in the pit.

Bedded confinement facilities typically involve more labor in cleaning and land application. Manure may be handled twice if it is stockpiled after removal from the building and awaiting land application. Some ammonia will volatilize as the manure dries. Nutrient concentration and quantity of the manure and bedding is variable depending on the size of the animal and pen density. It is estimated that five tons (wet basis) of bedded manure per year per head space is produced in a deep-bedded facility.

Slatted floor confinement buildings capture more nutrients, which is attributable to less volatilization and reduced environmental interaction. Because the manure is liquid, it can be injected or incorporated more easily, lowering potential nutrient losses.

The pit provides manure storage until it can be land-applied. Manure handling and land application typically occurs over a few days during the year but requires expensive pumping, manure hauling, and injection equipment that is only used for a few days a year. Hence, many operations use custom operators to move and apply liquid manure. It is estimated that one head space will produce 2,500 gallons of manure per year.



Manure Nutrient Concentration and Value

The value of manure is based on the amount of nutrients produced and the availability of these nutrients for crop production. Tables 6, 7, and 8 (on page 18) compare the quantity and nutrient concentration of beef manure across types of facilities. Sources for this information report varying amounts. Individual operation data also will vary from those reported. Managers need to sample and test manure to get an accurate representation for their operations. The estimated handling and land application costs will be used in the systems cost analysis. The following sources were reviewed for this information.

[Midwest Plan Service Handbook](https://www-mwps.sws.iastate.edu/catalog/manure-management-livestock/sect-1-manure-characteristics). 18 Sec. 1, 2004. Manure characteristics. <https://www-mwps.sws.iastate.edu/catalog/manure-management-livestock/sect-1-manure-characteristics>

[NRCs Ag Waste Management Field Management Handbook](ftp://ftp.wcc.nrcs.usda.gov/wntsc/AWM/handbook/ch4.pdf). <ftp://ftp.wcc.nrcs.usda.gov/wntsc/AWM/handbook/ch4.pdf>

[ASAE Standards](http://extension.psu.edu/animals/dairy/nutrient-management/certified-dairy/tools/manure-prod-char-d384-2.pdf). 2005. D384.2 Manure production and characteristics. <http://extension.psu.edu/animals/dairy/nutrient-management/certified-dairy/tools/manure-prod-char-d384-2.pdf>

[A Survey of Manure Characteristics from Bedded Confinement Buildings for Feedlot Beef Production](http://www.ans.iastate.edu/report/air/2010pdf/R2526.pdf). Russ Euken, 2010, Iowa State University Animal Industry Reports AS-Leaflet-R2526. <http://www.ans.iastate.edu/report/air/2010pdf/R2526.pdf>

Fertilizer Value of Manure. University of Minnesota, 2014A. DiCostanzo N. M., Kenney Rambo, University of Minnesota, St. Paul and A. Nesseth, Extended Ag Services, Lakefield, Minnesota. Contact: Nicole Kenney-Rambo at nmkenney@umn.edu or 320.235.0726, ext. 2009.

[Capturing, managing, and using nutrients from the barn](https://store.extension.iastate.edu/Product/Beef-Facilities-Conference-Proceedings). Kris Kohl, Extension Field Ag Engineer; Angela Rieck-Hinz Field Agronomist, Iowa State University, Four State Beef Facilities conference. <https://store.extension.iastate.edu/Product/Beef-Facilities-Conference-Proceedings>

[Summary of Manure Amounts, Characteristics, and Nitrogen Mass Balance for Open Feedlot Pens in Summer Compared to Winter](http://digitalcommons.unl.edu/animalscibcr/133/). Galen E. Erickson, Terry J. Klopfenstein, University of Nebraska - Lincoln. <http://digitalcommons.unl.edu/animalscibcr/133/> University of Nebraska 2006 Beef Research Reports

Jeff Lorimor, Iowa State University, Agricultural Engineer. Survey of open feedlot manure characteristics-not published.



Land Application and Crop Utilization of Beef Manure

In determining application rates and manure value, it should be noted that not all of the nutrients in beef manure are available for crop production in the first year of application (Table 9). [ISU publication PM 1003](#) (Using Manure Nutrients for Crop Production) explains the availability in more detail. <https://store.extension.iastate.edu/Product/Using-Manure-Nutrients-for-Crop-Production>

Table 6. Estimated nutrient concentration per ton or per 1,000 gallon

	N lbs.	P ₂ O ₅ lbs.	K ₂ O lbs.
Solid manure from open lots-variable DM	15	8	11
Liquid run off from open lots-5% DM	1.8	.75	4
Manure from bedded confinement-30% DM	18	11	14
Liquid deep pit manure-10% DM	45	24	36

Table 7. Estimated manure and urine and nutrient excretion

	Tons	N lbs.	P ₂ O ₅ lbs.	K ₂ O lbs.
Estimated excreted nutrients per head per year	6 tons at 92% moisture 60 pounds per day	125	65	100

Table 8. Estimated manure nutrients – Annual amount of manure and nutrients per head space

	Estimated annual amount of manure per head-tons or gallons for application	N lbs.	P ₂ O ₅ lbs.	K ₂ O lbs.
Solid manure from open lots	3 tons	45	24	33
Liquid run off from open lots	2,700 gallons	5	2	11
Manure from bedded confinement	5 tons	90	55	70
Deep pit manure	2,500 gallons	113	60	90

Table 9. First year nutrient availability

	Nitrogen ¹	Phosphorus ²	Potassium ²
Beef cattle manure (liquid or solid)	Percent of total nutrient applied		
	30-40	60-100	90-100

¹The estimates for nitrogen (N) availability do not account for potential volatile N losses during and after land application.

²The ranges in P and K availability are provided to account for variation in sampling and analysis, and for needed P and K supply with different soil test levels. A small portion of manure P may not be available immediately after application, but all P is potentially available over time. Use lower P and K availability values for soils testing in the Very Low and Low soil test interpretation categories, where large yield loss could occur if insufficient P or K is applied and a reasonable build up is desired. Use 100% when manure is applied to maintain soil test P and K in the Optimum soil test category, when the probability of a yield response is small.

Second year and third year availability of beef manure nitrogen is 10% and 5%, respectively. Even if P and K are not 100% available in year 1 of application, it all will become available over time.

Producers also recognize that application of manure from open lots and deep-bedded confinements can be variable and if not incorporated soon after application, weather conditions may cause additional nitrogen loss. If not injected or incorporated within 24 hours after application, up to 25% of the nitrogen in manure can volatilize. In addition, surface runoff of manure nutrients with soil erosion or with manure applied on snow can result in loss of phosphorus and potassium from the manure.

Table 10 provides a value for manure assuming no application losses. This also assumes that the manure nutrients applied are replacing commercial fertilizer that is valued at the cost per unit shown.

Table 10. Estimated manure value per head space per year. Based on 50% N availability, 100% P₂O₅ and K₂O availability, \$0.50 per pound N, \$0.55 per pound P₂O₅, \$0.50 per pound K₂O, application cost not included.

	N value	P ₂ O ₅ value	K ₂ O value	Total value
Solid manure from open lots	\$ 11.25	\$ 13.20	\$ 16.50	\$ 40.95
Liquid manure from open lots	\$ 1.25	\$ 1.10	\$ 5.50	\$ 7.85
Manure from bedded confinement	\$ 22.50	\$ 30.25	\$ 35.00	\$ 87.75
Deep pit manure	\$ 28.25	\$ 33.00	\$ 45.00	\$ 106.25

Typically, when manure is applied to land for corn production and applied to meet the corn crop's nitrogen needs, the amount of phosphorus (P) and potassium (K) will exceed the amount of P and K needed in one year. Application of beef manure to crops every year will build P and K levels and reduce the relative value of the manure. Each operator needs to determine how to maximize the value of manure nutrients by determining which crops and fields will best utilize all the nutrients being applied.

Applying manure nutrients for multiple crop years is acceptable for P and K as long as the field is not at high risk for phosphorus runoff as determined by the phosphorus index. Application of nitrogen that exceeds the crop needs in the year of application can lower the value of the manure and may violate a manure management plan. Additional phosphorus and potassium in the manure not utilized by the crop in the application year are available for use by crops after the application year.

To utilize manure for crop production it is important to know the nutrient concentration in the manure. Individual operations should sample and analyze manure samples rather than using book values. Understanding the supply of nutrients available for the crops, coupled with accurate and timely application and incorporation of the manure, will optimize use of the manure value.

Environmental Regulations Related to Manure and Runoff from Beef Feedlot Facilities

The federal Clean Water Act regulates Concentrated Animal Feeding Operations (CAFO). CAFOs are defined by a combination of size and discharge conditions that could pollute waters of the United States. For beef feeding operations, any site with a total capacity of 1,000 head or more is considered a CAFO. An operation with 300 head or more which is crossed by a water of the U.S. or which discharges pollutants to a water of the United States through a man-made drainage system (including pipes, culverts, tile lines and road ditches) also is considered a CAFO. Any CAFO that discharges pollutants to a water of the U.S. must obtain an NDPEs permit, install approved runoff control measures, follow an approved Nutrient Management Plan (NMP), and file required records.

In addition to federal CAFO rules, Iowa law requires that all open feedlots, regardless of size, must remove settleable solids from open lot runoff and must manage the resulting settled effluent and any collected manure solids in a manner that prevents water quality violations in receiving waters of the State.

Iowa confinement (under roof) cattle feeding operations with a capacity of 500 head or more must meet certain construction requirements, file and follow an approved manure management plan, and have manure handled and applied by a certified manure applicator. In addition, confinement operations of 1,000 head or more must have a construction permit approved prior to the beginning of construction.

Separation distance requirements to neighboring properties, wells, and water resources may apply for confinement buildings, solids settling, and manure application, storage, and stockpiling. Some construction restrictions apply in areas of karst topography, alluvial aquifers, and floodplains.

Complete detail about environmental regulations for beef feeding operations is available from the [Iowa Department of Natural Resources](http://www.iowadnr.gov/Environment/LandStewardship/AnimalFeedingOperations.aspx) at <http://www.iowadnr.gov/Environment/LandStewardship/AnimalFeedingOperations.aspx>

[The Iowa Manure Management Action Group](http://www.agronext.iastate.edu/immag/) (IMMAG) <http://www.agronext.iastate.edu/immag/> has additional information about environmental stewardship for livestock operations along with links to information from regulatory agencies.

Facilities Resource and Cost Analysis

Initial investment, operating costs, cattle performance, and manure value play a large role in facility decisions. Tables 11 to 20 compare required resources initial investment, annual non-feed operating cost per head, cost per pound of gain, and yardage for the types of facilities described previously. Finally, the net cost of gain is derived by crediting the potential manure nutrient value from each type of system.

Land Area Required

Table 11 describes the land area needed which includes area for the cattle pens, 20% additional area for open lots for runoff controls, plus 0.5 acres for additional lanes for all types of facilities.

The acres for manure application are based on 180 pounds of N applied per acre every other year in a corn-soybean rotation. The corresponding P_2O_5 application rate is between 95 pounds to 110 pounds and K_2O application rate is between 130 pounds to 145 pounds varying by facility type. These acres do not need to be owned or operated by the feedlot owner but manure value is optimized only when there are an appropriate number of acres to utilize the nutrients. Total volume of manure per head, and nutrient concentration and availability assumed in the calculation is the same as in section discussing manure management. For different crop rotations or manure application rates crop acres would vary.

It is assumed the land for the facility was already owned; hence, no investment cost is calculated for land, however a rental rate of \$250 per acre is charged for land in calculating annual operating costs. If a site for the feedlot must be acquired, this investment cost needs to be included in the initial investment.

Labor Requirements

Data on labor requirements for feeding cattle are limited, but it is an important consideration when considering feedlot facility type. A common number that is used is 1.0 full-time equivalent (FTE) or approximately 2,100 hours per year per 1,000 head. Information on difference in labor requirements by different facility types has not been thoroughly investigated, but it is apparent there would be differences in labor requirements. Assumptions were made on hours for cattle feeding and care, facility maintenance, and manure handling and bedding, assuming the facility is used year round. It does not include time spent on managing the operation. Labor per head will likely be less as the size of the operation increases but no attempt was made to scale labor requirements by operation size. Size of equipment and type of feeding system or feeding frequency could alter labor requirements as well.

Also, average labor requirements were estimated but those averages will vary throughout a season or feeding period and will have both peak and lower times of demand. If labor is not sufficient for those peak demand periods the operation may not be able to complete some tasks. For

Table 11. Land area in acres per 500-head capacity by facility type

	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
Facility footprint	2.57	2.57	1.46	0.97	0.76
Total acres for manure nutrient utilization (application to one half of the acres every other year)	300	300	300	500	625

Table 12. Hours of labor estimated for cleaning and bedding including land application

	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
Hours / week /150-head	0.8	0.8	0.9	1.1	0.4
Hours / head space / year	0.28	0.28	0.31	0.38	0.14

some systems like a pit building, all manure handling will occur in short time frame and the labor requirement might be part of a custom-hired job. In that case total labor for the systems would include only the feed and daily care.

To establish the assumptions, it was estimated that feeding, pen checking, and normal handling of cattle would require 3.5 hours of labor per day for 500 head of cattle or about 2.5 hours per head space per year, regardless of the type of the facility. The assumed difference in labor requirements by facility type for pen maintenance, cleaning, manure handling and land application, and bedding are shown in Table 12. A pen size of 150 head was used to provide reference and the hours per head space per year was calculated from the labor assumption for the pen. In the case of a slatted floor confinement, weekly labor was back calculated from estimates of time required for pit pumping and manure application two times per year.

As a comparison, an ISU study compared the labor for cleaning pens, manure application, and bedding a deep-bedded hoop facility versus an open lot with shed for cattle fed in summer and fall season. Groups of 120 head were fed in three pens of 40 head in each facility. The calculated average of labor for the open lot with shed and hoop facility was 0.55 and 0.64 hours per head space per year, or on a weekly basis for 150 head, 1.86 and 1.61 respectively, which are higher than the estimates in Table 12. The study was conducted on small pens of 40 head per pen, which could increase time for cleaning pens.



Using these assumptions for cleaning and bedding along with feeding and daily care, the labor estimates for each system were calculated and are reported in various ways in Table 13.

Operator labor will be seasonal and likely will be higher than average in periods of wet weather in open lots but more consistent in confinement buildings.

Table 13. Hours of labor across systems using average assumptions

	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
Per head space/year manure handling	0.28	0.28	0.31	0.38	0.14
Per head space/year feed and care	2.04	2.04	2.04	2.04	2.04
Total hours per head space per year	2.32	2.32	2.35	2.42	2.18
Per calf per turn, 180 days	1.15	1.15	1.16	1.20	1.08
Per yearling per turn, 140 days	0.89	0.89	0.90	0.93	0.84
Total per week for 500 head	27.24	27.24	27.58	28.24	25.90
Cleaning, bedding, manure handling	2.74	2.74	3.08	3.74	1.4
Feed and care	24.5	24.5	24.5	24.5	24.5
Total per year for 500 head	1,417	1,417	1,434	1,469	1,347
Cleaning, bedding, manure handling	143	143	160	195	73
Feed and care	1,274	1,274	1,274	1,274	1,274



Initial Investment

The initial investment required to construct a feedlot can vary from one location to another even if the facility is the same. This can be attributed to differences in site preparation but building options and the amount of hired- or owner-labor affect actual construction price.

Contractors who have constructed confinement facilities were contacted to obtain turnkey bids on confinement facilities with labor included. The averages of their survey responses are shown in Table 14. Bunks, waters, gates were either included in the bid or estimated from other bids. Labor to build the facility is included. Any preparation such as site leveling, providing utilities to a site, or water supply was not included. Constructed manure storage additional to pen space for bedded confinement buildings was not included. Square foot per head was calculated from the survey responses and adjusted to 40 square feet per head for deep-bedded buildings and 23 square feet per head for slatted floor buildings and costs are listed on a per head basis.

There were differences in building design such as available bunk space, curtains, type of pen division, pit area, roof insulation or wood frame versus steel frame that affected costs of buildings.

These estimated costs ranged from \$643 to \$753 per head with an average of \$666 per head for gable and monoslope bedded confinement. Hoop or fabric-type bedded confinement buildings ranged from \$620 to \$710 and averaged \$630 per head. In this analysis, an overall average of \$651 for bedded confinement buildings is being used.

For deep pit confinement buildings, gable and monoslope costs ranged from \$1,100 to \$1,374 per head and averaged \$1,277 per head. Hoop or fabric deep pit buildings ranged from \$880 to \$951 per head space and averaged \$914 per head. An overall average was \$1,121 for pit buildings. Rubber mats were included in all the bids and typically added approximately \$175 per head space.

The averages used in this analysis are not meant to represent any specific brand of building or design. The ranges in estimated costs show the need to look at options and understand how specific design options influence the cost of the facility. In this analysis, \$100 of investment for confinement building is approximately \$14.50 per head in annual cost. Increasing the investment to \$300 per head would change annual cost per head by \$43.50, per head per day cost by \$.12 and the cost of gain per lb. by \$.034 and \$.035 for yearlings and calves respectively.

Table 14. Initial investment per head

	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
Lot, building, feed bunk, and fence	\$ 196	\$ 573	\$ 723	\$ 651	\$ 1,121
Feed storage, feed handling, cattle handling	\$ 65	\$ 65	\$ 65	\$ 65	\$ 65
Environmental structures and engineering < 1,000 head	\$ 56	\$ 56	\$ 51	\$ 0	\$ 0
Environmental structures and engineering > 1,000 head	\$ 138	\$ 138	\$ 133	\$ 4	\$ 4
Total cost < 1,000 head	\$ 317	\$ 694	\$ 839	\$ 716	\$ 1,185
Total cost >1,000 head	\$ 399	\$ 776	\$ 921	\$ 720	\$ 1,189

For open feedlots, estimated material costs and labor involved in construction were used to calculate costs. The two largest cost items were buildings priced at \$9 per square foot and concrete which was priced at \$4.65 per square foot. Bunks were priced at \$35 per foot. The open lots with sheds include a drive through covered feed alley that adds \$125 to per head investment. A covered feed alley is not included in all of the confinement building designs and cost. The initial investment for open lots also is outlined in Table 14.

Environmental control structures and the engineering cost will vary with size of an open lot facility. Open lots with capacity below 1,000 head may have a great deal of difference in costs for runoff control. Some operations may require no engineering and have very simple systems that control runoff and have less cost than in the assumptions. In this analysis, engineering fees for these lots is estimated at \$8,500 and the investment to build control structures is \$25 per head space. Systems to pump the effluent and land apply are estimated at \$15,000. The cost for open lots below 1000 head capacity in the following tables is based on 750 head capacity.

For open lots above 1,000 head, engineering costs are greater but per head costs decrease as size increases above 1,000 head as the cost is spread over more cattle. In this analysis engineering fees are \$45,000, construction cost for control structures is \$55 per head space, and the irrigation system to dewater and land apply feedlot runoff is estimated to cost \$80,000. The engineering costs and environmental control costs for less than 1,000 head capacity in open lots are based on 1,500 head capacity with total containment and irrigation equipment for pumping the effluent from the containment and land application.

An estimated cost of feed storage, feed handling, and cattle handling and processing facilities also is included in Table 14. It is assumed those cost would not vary by type of facility, but it's recognized that type of feed storage and handling, and animal handling could vary greatly from one operation to another and be different than the assumptions made.

As mentioned, feed storage cost estimates are approximately \$25 per head, feed handling equipment is estimated at \$25 per head, and animal handling and processing equipment is an additional \$10 per head of capacity. Building space was not included in the cost for the animal handling area, just equipment and fencing. As these costs are spread over more animals, the per-head costs would change considerably. Obviously there are many options in types of equipment and individual operation situations that would affect these initial investment costs.

Investment cost per head is highest for confinement slatted floor facilities. Manure storage included with the pit is part of this higher investment. From the estimated costs obtained there is a lot of range in the cost of this kind of system. The confinement slatted floor is followed in amount of initial cost by the concrete lot with shed and the confinement with solid floor. The earthen lot with shed follows the solid floor confinement except for the above 1,000 head lot. The additional environmental engineering and controls make the above 1,000 head lot earthen lot with shed slightly higher investment than the confinement with solid floor. The earthen lot with a windbreak is the lowest investment at about one-third the cost of a slatted floor confinement and about one-half the investment of the other types of facilities.

Nonfeed Fixed and Variable Cost of Facility Types

Annual non-feed costs per head across facility types are shown in Tables 15 and 16. The annual payment uses the total initial investment listed in Table 14 and the assumptions listed following the tables and useful life and repair rate in Table 17. Labor for processing, treating, and feeding cattle will be the same for all systems, but labor to

clean, haul manure, and bed pens will vary with facility type as shown in Tables 12 and 13. Other non-feed costs include veterinary and medicine, death loss, interest on feed and feeder, operating expenses for feeding equipment, and marketing costs. Those costs are estimated at \$61 per yearling and \$70 per calf. The main difference between the below 1,000 head capacity and above 1,000 head capacity is the cost of environmental controls for open lots.

Table 15. Annual and per day non-feed costs per head space < 1,000 head capacity

	Unit	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
YEARLING STEERS						
Building lot ownership	\$/head/year	\$ 23.06	\$ 76.66	\$ 89.21	\$ 93.54	\$ 160.77
Feed storage handling	\$/head/year	\$ 8.52	\$ 8.52	\$ 8.52	\$ 8.52	\$ 8.52
Environmental controls	\$/head/year	\$ 6.19	\$ 6.19	\$ 5.72	\$ -	\$ -
Manure handling	\$/head/year	\$ 9.41	\$ 9.41	\$ 12.41	\$ 15.00	\$ 25.00
Bedding	\$/head/year	\$ 13.99	\$ 13.99	\$ 13.99	\$ 34.98	
Labor	\$/head/year	\$ 33.84	\$ 35.21	\$ 35.73	\$ 36.79	\$ 33.10
Other non-feed costs	\$/head/year	\$ 154.52	\$ 160.75	\$ 160.75	\$ 160.75	\$ 160.75
Total	\$/head/year	\$ 249.53	\$ 310.73	\$ 326.34	\$ 349.58	\$ 388.14
Facilities ownership						
Facilities ownership	\$/head/day	\$ 0.06	\$ 0.21	\$ 0.24	\$ 0.26	\$ 0.44
Feed storage handling	\$/head/day	\$ 0.02	\$ 0.02	\$ 0.02	\$ 0.02	\$ 0.02
Environmental controls	\$/head/day	\$ 0.02	\$ 0.02	\$ 0.02	\$ -	\$ -
Manure handling	\$/head/day	\$ 0.03	\$ 0.03	\$ 0.03	\$ 0.04	\$ 0.07
Bedding	\$/head/day	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.10	\$ -
Labor	\$/head/day	\$ 0.09	\$ 0.10	\$ 0.10	\$ 0.10	\$ 0.09
Other non-feed costs	\$/head/day	\$ 0.42	\$ 0.44	\$ 0.44	\$ 0.44	\$ 0.44
Total	\$/head/day	\$ 0.68	\$ 0.85	\$ 0.89	\$ 0.96	\$ 1.06
STEER CALVES						
Building lot ownership	\$/head/year	\$ 23.06	\$ 76.66	\$ 89.21	\$ 93.54	\$ 160.77
Feed storage handling	\$/head/year	\$ 8.52	\$ 8.52	\$ 8.52	\$ 8.52	\$ 8.52
Environmental controls	\$/head/year	\$ 6.19	\$ 6.19	\$ 5.72	\$ -	\$ -
Manure handling	\$/head/year	\$ 9.41	\$ 9.41	\$ 12.41	\$ 15.00	\$ 25.00
Bedding	\$/head/year	\$ 13.99	\$ 13.99	\$ 13.99	\$ 34.98	
Labor	\$/head/year	\$ 34.17	\$ 35.53	\$ 36.06	\$ 37.12	\$ 33.40
Other non-feed costs	\$/head/year	\$ 139.25	\$ 144.78	\$ 144.78	\$ 144.78	\$ 144.78
Total	\$/head/year	\$ 234.59	\$ 295.08	\$ 310.70	\$ 333.95	\$ 372.47
Facilities ownership						
Facilities ownership	\$/head/day	\$ 0.06	\$ 0.21	\$ 0.24	\$ 0.26	\$ 0.44
Feed storage handling	\$/head/day	\$ 0.02	\$ 0.02	\$ 0.02	\$ 0.02	\$ 0.02
Environmental controls	\$/head/day	\$ 0.02	\$ 0.02	\$ 0.02	\$ -	\$ -
Manure handling	\$/head/day	\$ 0.03	\$ 0.03	\$ 0.03	\$ 0.04	\$ 0.07
Bedding	\$/head/day	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.10	\$ -
Labor	\$/head/day	\$ 0.09	\$ 0.10	\$ 0.10	\$ 0.10	\$ 0.09
Other non-feed costs	\$/head/day	\$ 0.38	\$ 0.40	\$ 0.40	\$ 0.40	\$ 0.40
Total	\$/head/day	\$ 0.64	\$ 0.81	\$ 0.85	\$ 0.91	\$ 1.02

Table 16. Annual and per day non-feed costs per head space > 1,000 head capacity

	Unit	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
YEARLING STEERS						
Building lot ownership	\$/head/year	\$ 22.82	\$ 76.42	\$ 88.97	\$ 93.54	\$ 160.77
Feed storage handling	\$/head/year	\$ 8.48	\$ 8.48	\$ 8.48	\$ 8.48	\$ 8.48
Environmental controls	\$/head/year	\$ 15.56	\$ 15.56	\$ 15.10	\$ 0.35	\$ 0.35
Manure handling	\$/head/year	\$ 9.41	\$ 9.41	\$ 12.41	\$ 15.00	\$ 25.00
Bedding	\$/head/year	\$ 13.99	\$ 13.99	\$ 13.99	\$ 34.98	
Labor	\$/head/year	\$ 33.84	\$ 35.21	\$ 35.73	\$ 36.79	\$ 33.10
Other non-feed costs	\$/head/year	\$ 154.52	\$ 160.75	\$ 160.75	\$ 160.75	\$ 160.75
Total	\$/head/year	\$ 258.62	\$ 319.81	\$ 335.43	\$ 349.89	\$ 388.45
STEER CALVES						
Facilities ownership	\$/head/day	\$ 0.06	\$ 0.21	\$ 0.24	\$ 0.26	\$ 0.44
Feed storage handling	\$/head/day	\$ 0.02	\$ 0.02	\$ 0.02	\$ 0.02	\$ 0.02
Environmental controls	\$/head/day	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.001	\$ 0.001
Manure handling	\$/head/day	\$ 0.03	\$ 0.03	\$ 0.03	\$ 0.04	\$ 0.07
Bedding	\$/head/day	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.10	\$ -
Labor	\$/head/day	\$ 0.09	\$ 0.10	\$ 0.10	\$ 0.10	\$ 0.09
Other non-feed costs	\$/head/day	\$ 0.42	\$ 0.44	\$ 0.44	\$ 0.44	\$ 0.44
Total	\$/head/day	\$ 0.71	\$ 0.88	\$ 0.92	\$ 0.96	\$ 1.06
STEER CALVES						
Building lot ownership	\$/head/year	\$ 22.82	\$ 76.42	\$ 88.97	\$ 93.54	\$ 160.77
Feed storage handling	\$/head/year	\$ 8.48	\$ 8.48	\$ 8.48	\$ 8.48	\$ 8.48
Environmental controls	\$/head/year	\$ 15.56	\$ 15.56	\$ 15.10	\$ 0.35	\$ 0.35
Manure handling	\$/head/year	\$ 9.41	\$ 9.41	\$ 12.41	\$ 15.00	\$ 25.00
Bedding	\$/head/year	\$ 13.99	\$ 13.99	\$ 13.99	\$ 34.98	
Labor	\$/head/year	\$ 34.17	\$ 35.53	\$ 36.06	\$ 37.12	\$ 33.40
Other non-feed costs	\$/head/year	\$ 139.25	\$ 144.78	\$ 144.78	\$ 144.78	\$ 144.78
Total	\$/head/year	\$ 243.67	\$ 304.16	\$ 319.78	\$ 334.25	\$ 372.78
STEER CALVES						
Facilities ownership	\$/head/day	\$ 0.06	\$ 0.21	\$ 0.24	\$ 0.26	\$ 0.44
Feed storage handling	\$/head/day	\$ 0.02	\$ 0.02	\$ 0.02	\$ 0.02	\$ 0.02
Environmental controls	\$/head/day	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.001	\$ 0.001
Manure handling	\$/head/day	\$ 0.03	\$ 0.03	\$ 0.03	\$ 0.04	\$ 0.07
Bedding	\$/head/day	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.10	\$ -
Labor	\$/head/day	\$ 0.09	\$ 0.10	\$ 0.10	\$ 0.10	\$ 0.09
Other non-feed costs	\$/head/day	\$ 0.38	\$ 0.40	\$ 0.40	\$ 0.40	\$ 0.40
Total	\$/head/day	\$ 0.67	\$ 0.83	\$ 0.88	\$ 0.92	\$ 1.02

Annual cost includes annual payment, estimated repairs, insurance, and taxes. Assumptions used in calculating annual costs are: land rent \$250/acre, interest rate 6%, property tax 1% of original investment, and insurance 0.5% of original investment.

Manure handling equipment cost without labor includes \$3 per ton for solid manure, \$0.01 per gallon for liquid manure by tank wagon, and \$.0001 per gallon for pumping.

Bedding costs are 2 pounds per head per day average for open lots and 5 pounds per head per day average for deep-bedded confinements. Bedding is priced at \$40 per ton.

Labor rate is \$15 per hour with annual hours from Table 13.

Non-feed operating cost for interest on veterinary and medicine, death loss, interest on feed and feeder, operating expenses for feeding equipment, and marketing costs were \$61 for yearlings and \$70 for calves per head per turn.

Table 17 lists the assumed depreciable life for each component used in calculating the annual cost. However, with proper care most of the components are expected to be functional for considerably longer. For confinement buildings, concrete, feed bunks, and fencing are included in building cost. As a result, those components have a higher calculated percent repair rate but longer life as compared to an open lot. Loan terms may be shorter than those shown which would increase the annual amount per head for facility related expense for the term of the loan.

Table 17. Depreciation life and repair rate

	Years	Rate
Building	25	5.0%
Concrete	25	1.0%
Feed bunk and waterer	20	2.0%
Fencing	15	2.5%
Windbreaks	20	3.0%
Commodity storage sheds	25	2.0%
Bulk bin for supplement	25	2.0%
Cattle handling equipment	20	5.0%
Feed handling equipment	20	5.0%
Environmental structures for open lots		
Engineering costs	25	0.0%
Construction costs	25	0.0%
Irrigation system	25	5.0%



The slatted floor confinement has the highest total annual non-feed cost mainly due to higher investment. The solid floor confinement is second highest in annual non-feed cost even though it was third highest investment. Bedding cost and slightly higher labor cost pushed the annual non-feed cost higher than the concrete lot with shed. The two earthen lots – with shed and with windbreak – follow in annual non-feed cost being about \$80 and \$130 per head less than the confinement with slatted floor and \$40 and \$100 less than the confinement with solid floor.

Cost Per Pound of Gain Costs by Facility Types

The annual costs previously listed were used to calculate a cost of gain in Tables 18a and 18b for yearling and steer calves, including performance assumptions outlined in earlier in the feedlot performance and facility type section on pages 14 and 15 of this manual. With the feed efficiency and gain improvements, the costs between systems narrow, but the highest to lowest cost follows the same order as the annual cost per head with the confinement systems being the highest and the open lots being the lowest. The earthen lot with windbreak has poorer feed efficiency and gain in the assumptions so the feed costs are higher for that system.

The feed prices used to calculate feed cost of gain are: corn – \$4.25/bushel, hay – \$125/T, modified distillers grains – \$65/T, and supplement \$0.30/pound.

Cost of gain was either equal or not more the \$0.01 difference within facility type for feedlots with capacity of either less than or greater than 1,000 head.

Table 18a. Cost of gain 100% occupancy

	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
YEARLING STEERS					
Non feed	\$ 0.20	\$ 0.24	\$ 0.25	\$ 0.27	\$ 0.29
Feed	\$ 0.62	\$ 0.59	\$ 0.59	\$ 0.59	\$ 0.59
Total	\$ 0.82	\$ 0.84	\$ 0.85	\$ 0.86	\$ 0.89
STEER CALVES					
Non feed	\$ 0.20	\$ 0.25	\$ 0.26	\$ 0.27	\$ 0.30
Feed	\$ 0.58	\$ 0.56	\$ 0.56	\$ 0.56	\$ 0.56
Total	\$ 0.79	\$ 0.81	\$ 0.82	\$ 0.83	\$ 0.86

Table 18b. Total cost of gain by number turns per year

	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
Two turns of YEARLINGS – 1,000 lbs. of gain per year					
	\$ 0.84	\$ 0.87	\$ 0.89	\$ 0.90	\$ 0.94
One turn of CALVES – 600 lbs. gain per year					
	\$ 0.86	\$ 0.93	\$ 0.95	\$ 0.99	\$ 1.06

Yardage Comparison by Facility Type

A typical yardage charge that covers the annual non-feed costs associated with operating the feedlot but not ownership of cattle also varies by system, with the confinement systems being higher than open lots. The yardage charge also varies by the percentage of time the facility is kept full. Yardage includes all non-feed costs except veterinary expenses, interest on cattle and feed, death loss, and marketing.



Table 19. Yardage cost (Facilities, equipment, labor, manure handling, bedding) (\$/head/day)

	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
< 1,000 head – occupancy rate					
75	\$ 0.42	\$ 0.62	\$ 0.68	\$ 0.76	\$ 0.91
85	\$ 0.37	\$ 0.55	\$ 0.60	\$ 0.67	\$ 0.80
95	\$ 0.33	\$ 0.49	\$ 0.54	\$ 0.60	\$ 0.71
> 1,000 head – occupancy rate					
75	\$ 0.46	\$ 0.66	\$ 0.71	\$ 0.77	\$ 0.91
85	\$ 0.40	\$ 0.58	\$ 0.63	\$ 0.68	\$ 0.80
95	\$ 0.36	\$ 0.52	\$ 0.56	\$ 0.60	\$ 0.72

Manure Value by Facility Type

Finally the manure value by type of facility calculated in the manure nutrient value and environmental stewardship section on page 18 are used to calculate a manure value per lb. of gain in Table 20a and net cost of gain in Table 20b.



Table 20a. Manure value per head and per pound gain

	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
\$/head/year	\$ 50.00	\$ 50.00	\$ 50.00	\$ 88.00	\$ 106.00
\$/gain	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.07	\$ 0.08

Table 20b. Net cost of gain with manure credit (Cost of gain used is for yearlings)

	Earthen lot with windbreak	Earthen lot with shed	Concrete lot with shed	Confinement, solid floor	Confinement, slatted floor
Cost per pound of gain	\$ 0.82	\$ 0.84	\$ 0.85	\$ 0.86	\$ 0.89
Manure value per pound of gain	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.07	\$ 0.08
Net cost per pound of gain	\$ 0.78	\$ 0.80	\$ 0.81	\$ 0.79	\$ 0.81

With the estimated costs and assumptions for performance and manure value the net cost per lb. of gain for a yearling does not vary a great deal. However, a \$0.01 per pound of gain cost difference is approximately \$5 per head difference in profit assuming the same market value. To be competitive, an increase in cost needs to be offset with greater efficiency or more output.

Summary of Cost Analysis by Facility Type

With the assumptions based on available research and the estimated facility cost, any improved feed efficiency, gain, or manure value offsets part – but not all – of the increased cost for higher cost facilities. This does not mean that operations with higher cost facilities cannot be competitive or profitable. Marketing and many other factors may come into play when determining profitability. The increased investment for some facility types could limit the size of operation if financing or equity is limiting. The increased investment in facilities can help manage weather-related poor performance for some groups of cattle and result in more consistent performance. Overall cost control balanced with efficiency, output, and analyzing the individual financial situation are important to justify increased investment.

Individual operations may experience or want to assume different costs, efficiency improvements, or output than what is assumed in the analysis above. Tables that show relative cost of investment and range of savings at varying levels of increased efficiency and feed costs are in the Appendix.

Many variables influence the cost and return of facilities types. Using a budget that includes the variables as to determine the cost and return is a good way to compare facility investment decisions. The Iowa Beef Center has developed a feedlot facility investment decision tool to aid in decisions regarding facility investment. It is a spreadsheet that can be downloaded and used on any computer with the Microsoft Excel spreadsheet application and is available on the [Iowa Beef Center website](http://www.iowabeefcenter.org/software_calculators.html) (http://www.iowabeefcenter.org/software_calculators.html)





Other Considerations in Beef Cattle Feedlot Systems

There are a number of aspects to consider when selecting a beef cattle feedlot system, and no particular system will likely excel in all aspects of consideration. Certainly cost is one of those factors to be considered. Facility owners will need to select the criteria most important to their own cattle feeding enterprises.

Siting a Facility

Determining the proper location for a feedlot facility takes planning and thought. Open lots need enough area to construct and manage environmental control structures, and should be located away from a water source to prevent any spills from reaching the water source. Soil features and topography also should be considered.

Feedlot facilities have regulatory separation distance requirements based on size of operation and type of facilities, but this should not be the only consideration. Impact on neighbors and public perception should also be considered. Placing confinement facilities in areas of alluvial soils, flood plains, or karst areas is regulated and restricted.

New Construction Versus Expansion or Renovation of Existing Facility

Building a new facility at a new site is often easier as existing facilities do not need to be considered. In some situations new facilities may work well with existing facilities. For example, an operation with existing open lots may use existing lots for starting cattle and then transition the cattle to newer confinement buildings. Managers need to understand how expansion of the operation will affect the regulatory requirements for the entire operation.

Integrating the Entire Operation

Most feedlots in Iowa will likely have other enterprises as well. Diversification is beneficial in that integration with other facets of the operation can improve overall efficiency of labor and resources. For example, feed or bedding could be produced on-farm, purchased, or contracted locally. Also sharing labor and equipment with other enterprises can reduce costs.

Scale of Operation and Labor Considerations

Managers need to determine which feedlot design will work for their operation. Some efficiencies can be gained as scale of the operation increases, but this can lead to other management challenges. For example, if the feedlot expansion requires additional labor, will expansion support adding a full-time or part-time employee? Another example could be sourcing enough bedding for a large deep-bedded facility.

Manure Storage and Handling

Each type of facility offers different options for manure storage and handling. For open lots, an operation must be controlled and contained. This includes handling and storing solid and liquid manure. Solids should be settled out, and the effluent contained or pumped to a crop field to use the nutrients. Settled solids and manure scraped from the lot surface can either be stockpiled or applied directly to land area if available.

The type of manure storage will affect the amount of land area required for the facility. In an open earthen lot, bedding and manure are typically allowed to accumulate throughout the winter, with removal and land application in the spring. In an open concrete lot, manure may be removed weekly and stockpiled until land application is feasible.

Some deep-bedded confinement facilities may contain a short-term manure storage area. These are usually located between two adjacent pens and provide temporary storage for a limited amount of manure. Deep-bedded hoop barns may have a temporary concrete manure storage area located externally at either end of the building. With deep-bedded confinement facilities, there may be a stockpile area located off-site from the facility. Cost of this area depends on whether the surface area is dirt or concrete.

Bedding

Open lots, regardless of the surface material and whether or not they contain a shed, are usually bedded in colder months when the ground is frozen. Average bedding utilization is approximately 2 pounds to 3 pounds of bedding per head per day. In the summer, open lots are typically not bedded. In a deep-bedded confinement system, the amount of bedding typically averages 5 pounds to 7 pounds of bedding per head per day and is continuous throughout the feeding period. Typically, more bedding is used during summer when greater humidity and increased water consumption lead to a wetter bedding pack. Of course, no bedding is required in a deep-pit confinement facility and that is a major reason why some operations choose this kind of facility.

Sourcing, cost, and time required to harvest, store, and bed the facility are important considerations with deep-bedded confinement facilities. The complexity of these decisions increases as the size of operation increases. Cleaning and bedding buildings can be scheduled but harvesting cornstalks can be challenging in wet years and may require additional labor and equipment.

Facility Materials

A concrete floor or wall will add expense. However, concrete can reduce the amount of time involved in cleaning and can potentially last longer than other surfaces or materials. Because of the cost and amount of concrete, a deep-pit confinement facility will cost more initially than a deep-bedded confinement facility.

The frame of a building can be steel or wood. The walls can be wood, metal fence, or concrete. Concrete will likely have less damage from cattle and equipment, but has higher initial investment.

Insulation in the roof of wide and narrow deep-bedded monoslope beef barns varies with producer. To reduce condensation in cold weather, some facility owners have chosen to insulate the steel roof with either plywood or spray foam insulation.

Facility Longevity and Upkeep

Facilities with a concrete surface usually have less maintenance than a facility containing an earthen surface. Concrete walls last longer than gates or wood from the wear and tear caused by cattle and pen cleaning. Also, a steel roof usually has a life span approximately twice as long as a canvas tarp roof. However, longevity of the facility is usually inversely related to the initial construction costs – i.e., a facility with a shorter life span usually costs less to build. The longevity of a facility needs to be considered relative to the anticipated continuance of the cattle feeding business.





Animal Stress and Comfort

Animal comfort is related to a number of factors such as the exposure to inclement weather, floor surface of the facility, and animal density.

Weather Impacts

Interest in confinement facilities in the upper Midwest is partly related to climate and weather stress on the animal. Cold stress is determined by several factors – temperature, wind speed, precipitation, the ground surface, and condition of the animal's hair coat. The number of days that a beef animal experiences cold stress varies from year to year. Offsetting cold stress events with shelter can improve cattle comfort and animal performance. Ambient temperature is only slightly changed with shelter. The greater benefit to the shelter may be in keeping the animal dry. Animals with clean, dry hair coats can withstand colder temperatures. If located and managed properly, the shelter can provide a dry, draft-free environment.

Hot, humid weather can easily create heat stress and possibly death of the animal. The degree of heat stress is influenced by coat color, cattle weight, animal density, ambient temperature, humidity, solar radiation, and wind speed. Sheds or shade structures in open lots can help reduce solar radiation and lower the effective temperature compared to an open lot with no shed or shade.

Construction of either structure will add to the initial facility cost.

Sheds and confinement buildings provide a more consistent environment for the cattle by helping to alleviate the extremes of hot or cold stress, but they are not always superior to open lot situations. When weather is moderate and weather stress is not an issue, there may be little or no benefit provided by shelter. When weather stress is extreme, there may be tremendous benefit provided by shelter.

Floor Surface

Given the choice of where to lie, a beef animal will likely first choose a soft, dry surface, with their next choice a harder, dry surface. Their last choice is a muddy or wet surface. Consequently, dry earth or dry bedding is likely to be the animal's preference. Concrete helps manage mud but without dry bedding it might not be the most preferred floor for animal comfort. Concrete slats can cause issues with lameness and animal movement.

Rubber mats on concrete slats help cushion the concrete slatted surface, help prevent feet and leg injuries and lameness, and enhance animal comfort. But there is limited research regarding their effect upon animal performance and comfort in commercial feedlot situations in the United States.

Another potential concern is the increased incidence of digital dermatitis (hairy heel warts) in cattle housed in deep-bedded confinements. The pathogenesis of digital dermatitis is not completely understood and further research could help determine potential relationships between housing type and incidence of disease.

Animal Density

The total cost of any facility does not change regardless of the number of animals contained in the facility. However, to pay off the initial cost of the facility more quickly, some producers will stock the facility with more animals. This reduces the cost per head space, but there could be a tradeoff with animal comfort and performance. Increased animal density will reduce bunk space and animal access to water space.

More square feet per head in an open lot earthen situation can reduce mud depth. Nebraska research estimated mud depth and benefits of bedding under winter environmental considerations. At temperatures around 16 °F, 250 square feet or 350 square feet of pen space per head produced similar depths of mud, but a 150 square foot allocation had approximately 1 inch deeper mud in the lot. Relative mud depth can affect performance, but increasing space per head requires more investment to control runoff from a larger lot.

Square foot allocations in open lots require good site preparation and excellent management in cleaning, scraping, and pen maintenance. Square foot allocations in a shed are set at a minimum to help reduce cost, but still allow all animals to be under roof and have floor space to lie down and move about.

A minimum of 40 square feet of space per head in bedded confinement buildings is suggested. It is preferred that animals use the bedded portion rather than the feed bunk apron for resting. If the layout of a 40-foot wide building allows 1 foot of bunk space per head, the apron would be 12 square feet, allowing 28 square feet for lying and resting on the bedded area.

As animal density in bedded facilities increases, the amount of moisture from manure and urine also increases. This can make the bedded surface wet and sloppy, particularly with high humidity and less evaporation. Without some moisture evaporation it is difficult to add enough bedding to keep the bedded area dry. In this scenario, reducing animal density will help improve animal comfort.

In an ISU study, researchers reported that mud scores for cattle in a hoop bedded facility were slightly lower than cattle in an open earthen lot with shelter. In another ISU study, animals provided more than 40 square feet per head, had a trend of improved performance but it was not statistically significant. No research with animal densities less than 40 square feet per head allocation in a bedded confinement has been reported.





Slatted floor confinements usually provide 22 square feet to 25 square feet per head and 6 inches to 9 inches of bunk space. Research related to animal density in slatted floor facilities has not been conducted.

Ventilation in Shelters

Shelters for beef cattle, whether part of an open lot or used strictly for confinement, need sufficient ventilation. Poor ventilation can cause moisture condensation and health problems in cattle. One of the main building objectives is to provide adequate air space in the building. Consequently, a high roof that increases air space helps with ventilation.

Inlets or openings should allow wind to flow through the building all of the time. Maximum airflow through the building is critical when temperatures are warmer. Adequate airflow is desired when temperatures are cold to remove moisture from the building.



Sunlight

Solar radiation influences effective temperature. Offering shade or reducing solar radiation in warm temperatures and maximizing solar radiation in cold temperatures should enhance cattle comfort.

Bunk Space and Building Layout

Building design affects the amount of bunk space allowed, and in some confinement buildings bunk space is limited to 6 inches to 9 inches per head. The common recommendation is 12 inches of bunk space per head. Managers need to make sure feed is available for cattle when they want to eat. Limiting bunk space may require more frequent feeding to ensure maximum intake.

Some building designs include a covered feed alley. Although such an alley offers no advantage – performance or otherwise – for the cattle, the drive-through feed alley may make it easier for the operator to observe cattle while feeding. It also can provide a route for cattle movement and handling that may not exist with other layouts.





Feedlot Systems Summary

There are many choices for feedlot operators to consider when investing in feedlot facilities. The first determination to make is whether cattle feeding is a profitable venture and can help their operation be cost competitive. Careful budgeting and financial analysis is important.

Each system has advantages and disadvantages and there may not be one perfect system for each individual operation. The decision involves many factors including overall scale of the operation, labor availability, financial capability, future plans for expansion, and options for other investments. The location may also affect the feasibility of various systems. Many locations are not suitable for an open lot but might work for a confined building.

The majority of cattle feeding in Iowa is done in open lots, with and without shelter. There has been growing interest in confinement facilities with an increasing number being constructed in the past 10 years. Initial investment is greater and annual costs are higher for these type of facilities. Confinement facilities do provide a more consistent environment for cattle and can improve environmental stewardship when compared with some open lot situations. Typical narrow margins in cattle feeding mean the additional cost of confinement facilities must be offset by improved efficiency and marketing to be competitive. Changes in feed cost will impact the value of changes in feed efficiency. When feed

is more expensive, the value of an improvement in feed efficiency has more value than when feed is less expensive.

Adverse weather can make feeding cattle in an open lot more costly at times and more variable, but in the long run those types of facilities certainly have lower investment at lower costs, and are still an option for many cattle feeders. Good management and environmental stewardship is certainly needed. Depending on the size of the operation flexible labor resources are needed to be sure they can handle the workload in times of adverse weather. Some operations may not have a good location to construct an open lot and manage potential runoff.

If cattle feeding profitability continues, there will likely be more expansion and interest in all types of facilities. In some situations a mixture of types of facilities may better fit the operation's financial situation, land base, and labor availability.

So, which kind of facility should producers build? There is not one answer or even an easy answer to this question. This publication presents an overview and comparison of facility types based on available research information. Every system and every individual operation will have unique challenges and opportunities. Multiple factors impact the decision of which facility type might be right for an individual operation.

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