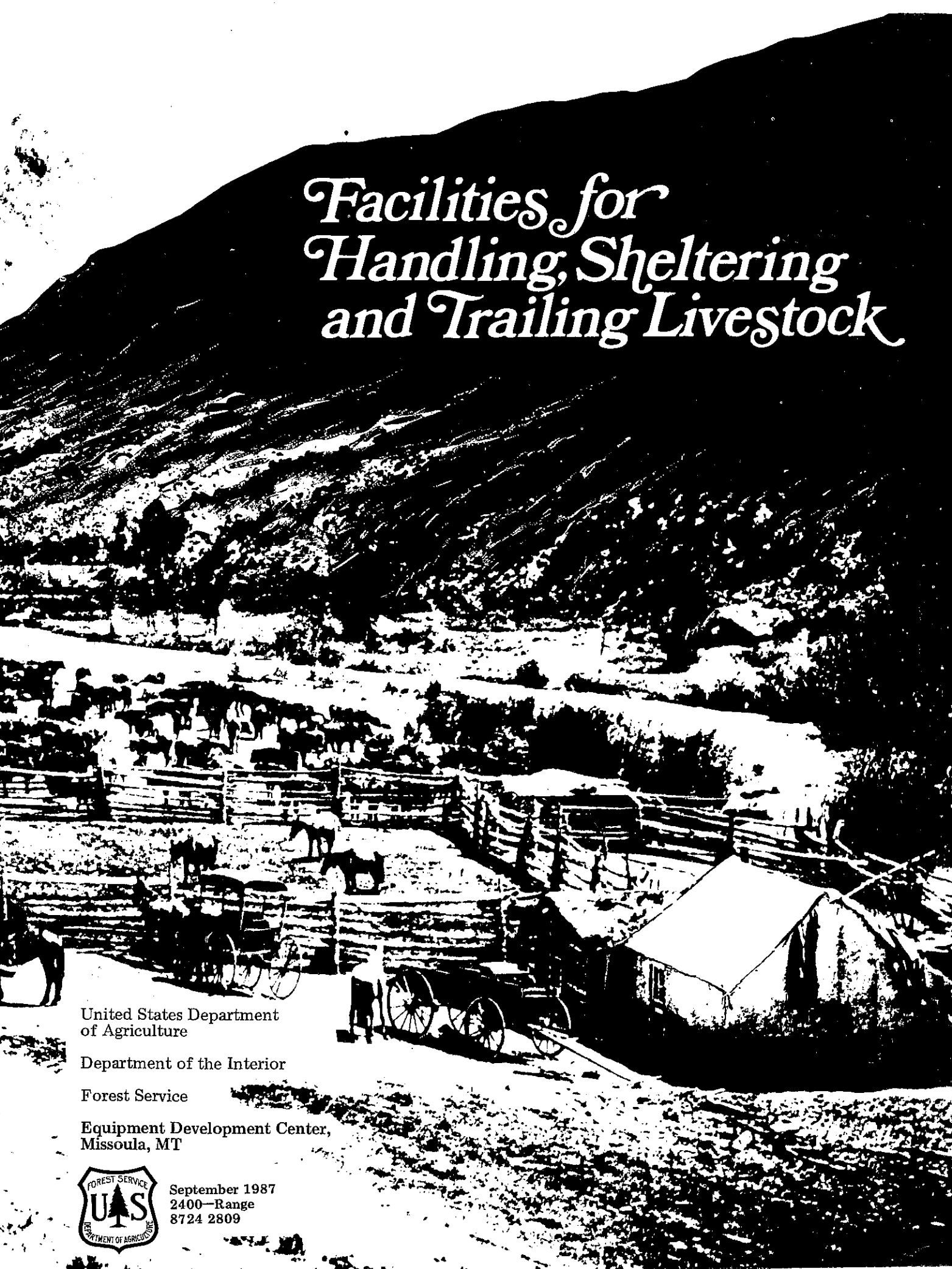
Facilities for Handling, Sheltering and Trailing Livestock



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Facilities for Handling, Sheltering and Trailing Livestock

Sponsored by
Vegetative Rehabilitation and
Equipment Workshop

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5E42D31—Range Structural Equipment
Range Structural Equipment Handbook

Cover photograph courtesy of Museum of the Rockies, Bozeman, MT

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

The mention of products and companies by name does not constitute endorsement by the USDA, nor does it imply approval of a product to the exclusion of others that may also be suitable.

The Vegetative Rehabilitation and Equipment Workshop (VREW) is an informal group of Federal and State Agencies, universities, professional organizations, and private citizens concerned with effective land management practices.

This manual was prepared at their request by the USDA Forest Service Equipment Development Center, Fort Missoula, Bldg. 1, Missoula, Montana 59801.

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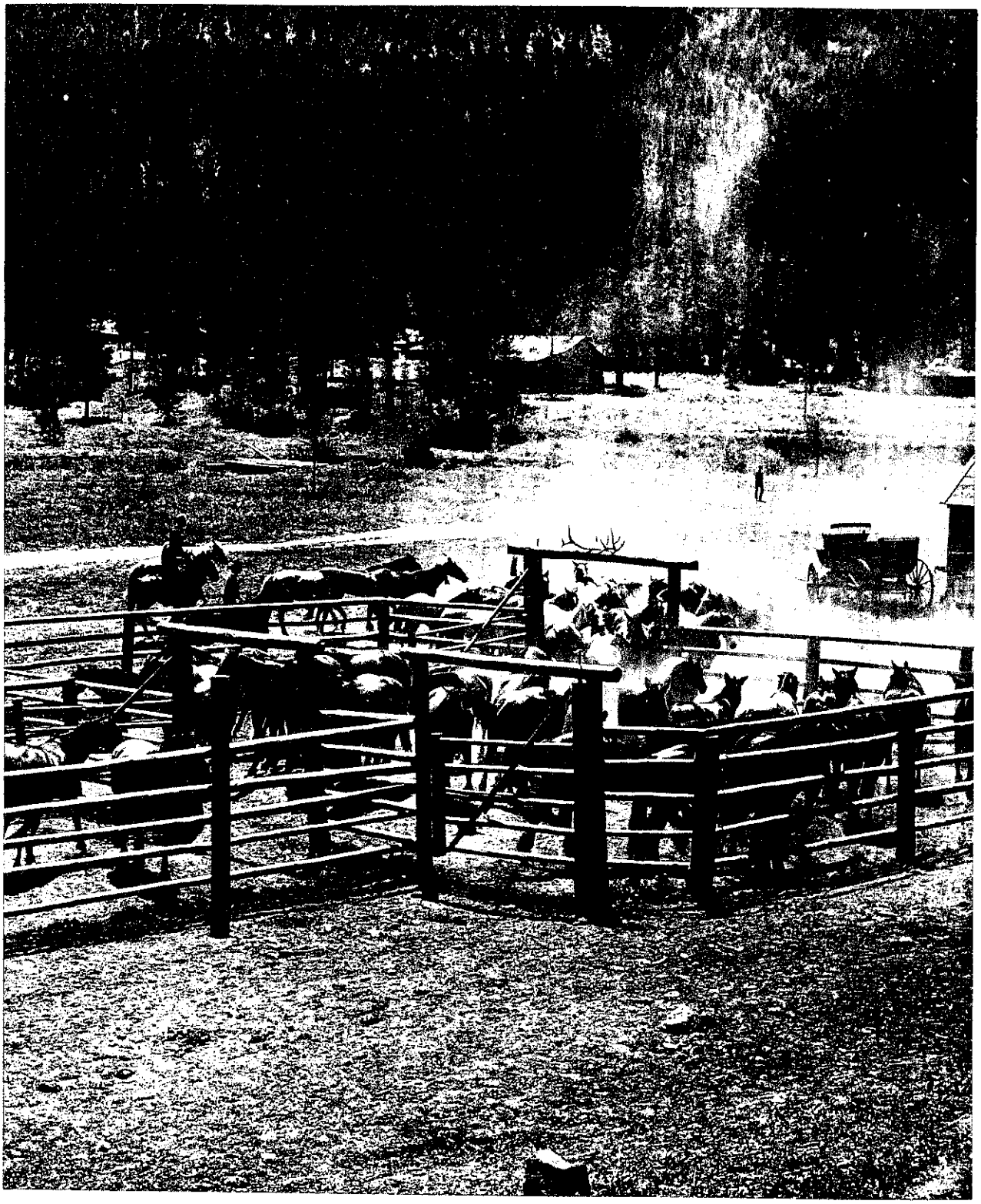


Photo courtesy Museum of the Rockies, Bozeman, MT

Introduction

As part of the continuing effort to develop and test revegetation equipment and provide information about suitable equipment to land managers, the Vegetative Rehabilitation and Equipment Workshop (VREW) has consolidated structural improvement handbooks now scattered through many federal agencies into:

Fences
Facilities for Handling, Sheltering, and Trailing Livestock
Water—Pumping and Piping Systems
Water—Damming and Storing

Each of the volumes describes components; uses; advantages and disadvantages; costs; safety and environment; and construction features. Where applicable, suggestions for redesign or new concepts for future development are included. Pertinent books and articles are cited.

The handling, sheltering, and trailing facilities discussed in this manual pertain to wildland livestock management. In this handbook, livestock are defined as horses, sheep, and cattle. Facilities discussed may apply to handling wildlife, but specific information for their management is not included.

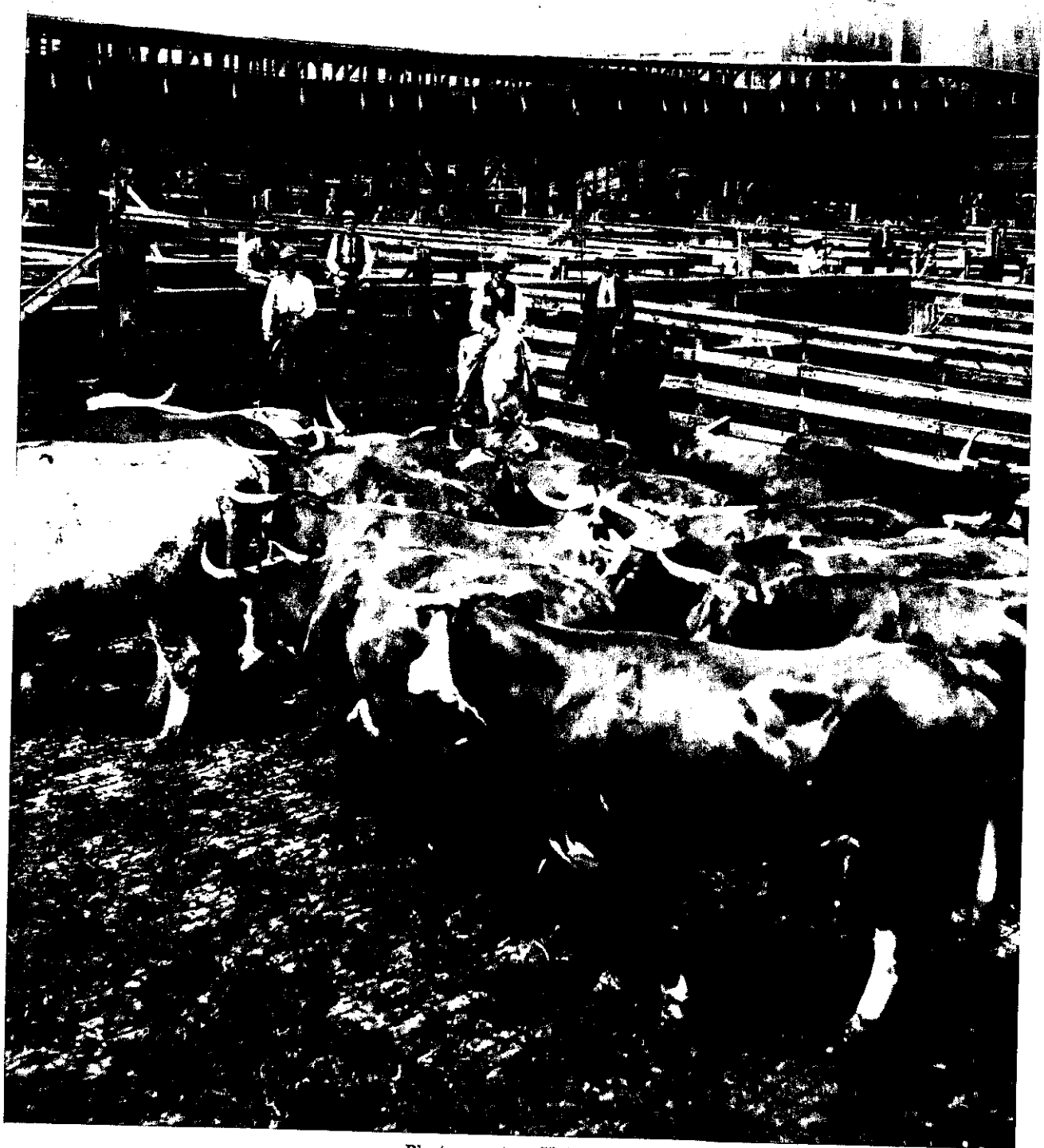


Photo courtesy University of Montana Mansfield Library, Missoula, MT

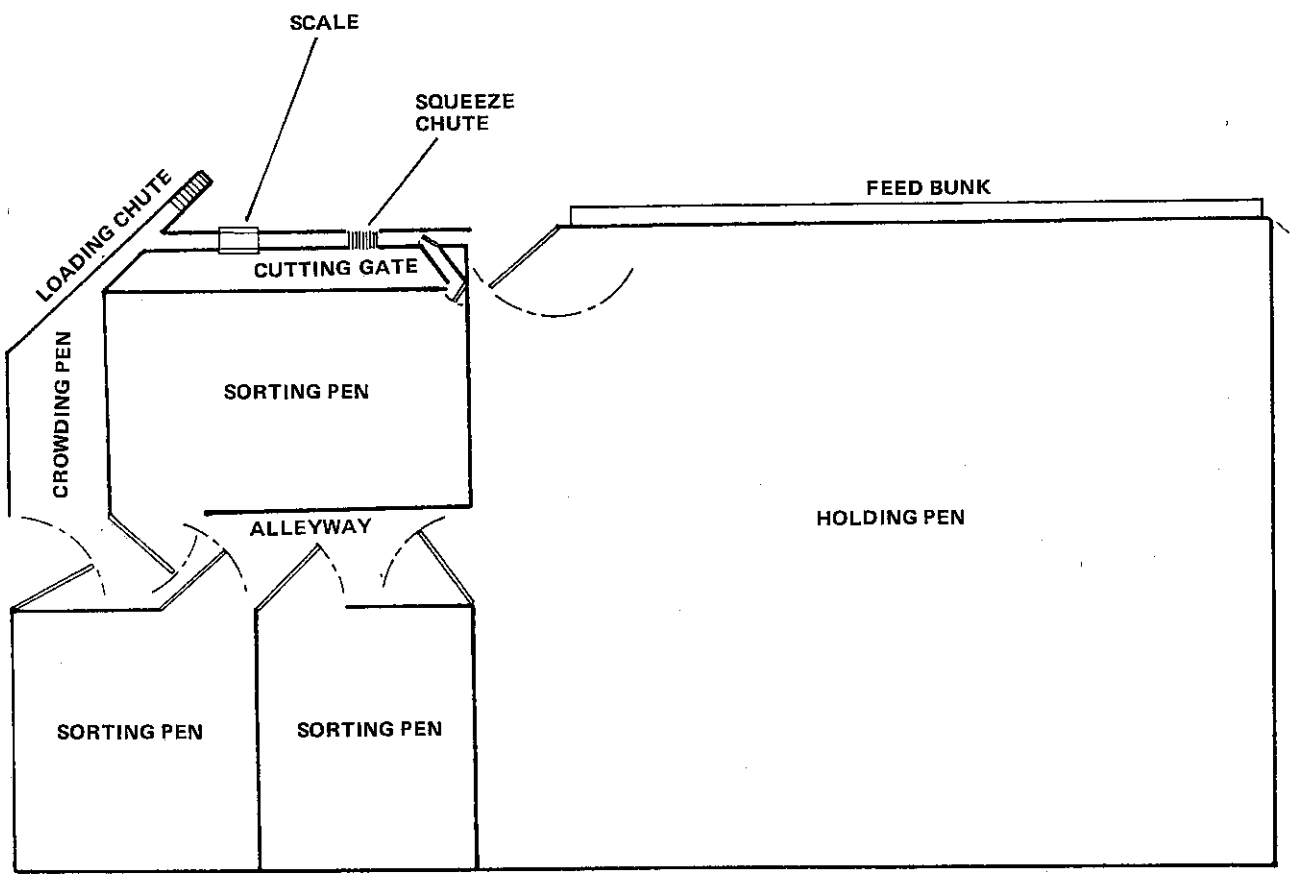
Livestock Handling Facilities

Livestock handling facilities are divided into three major categories: Corral systems; restraining facilities, and miscellaneous facilities. Livestock handling facilities are built to confine animals or control them during sorting, weighing, transporting, or while applying pesticides or insecticides.

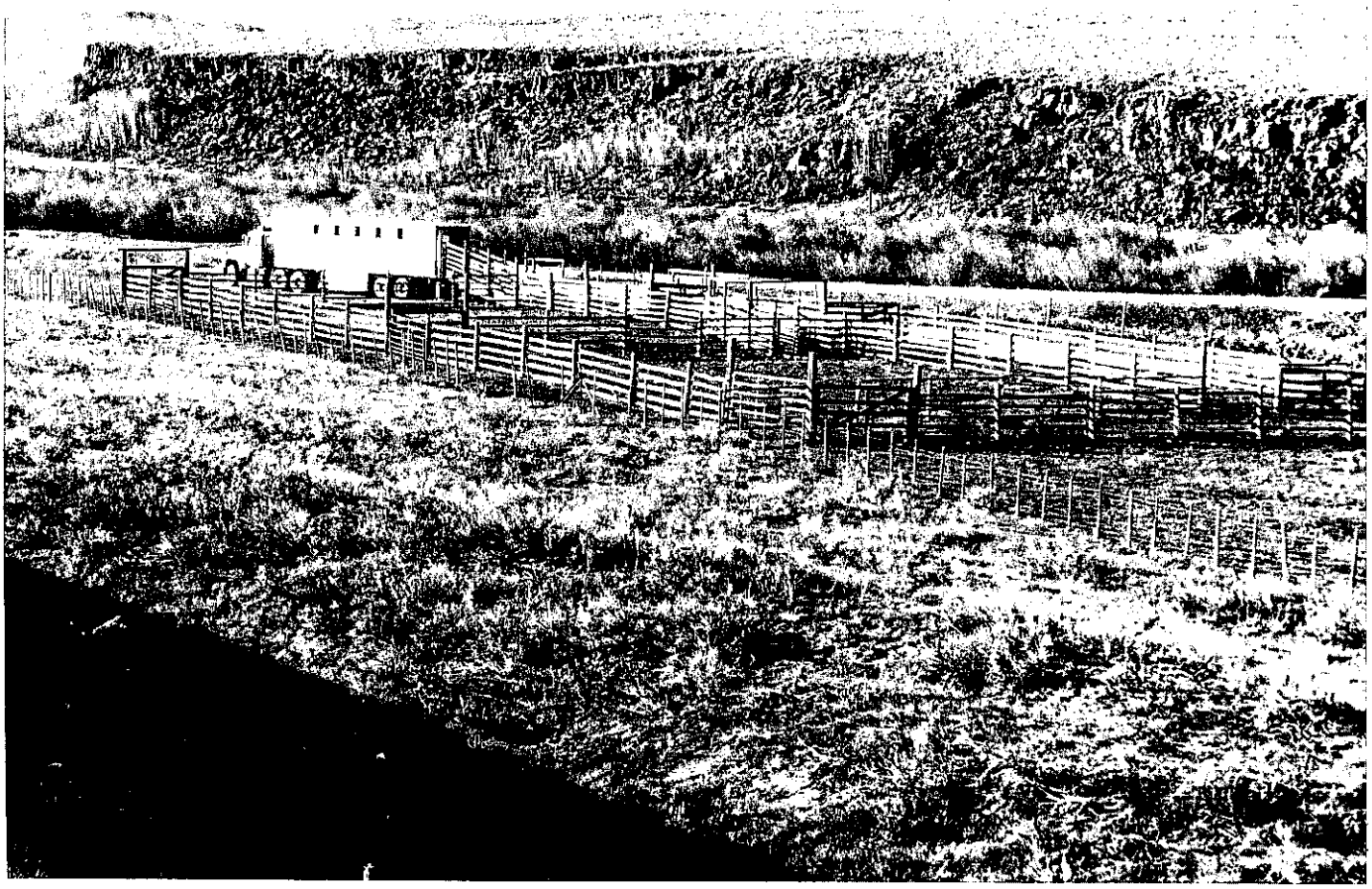
Not all handling facilities will include every element discussed because needs at each site will dictate components. For example, a pest control facility may not be needed for a handling facility intended to transport livestock to and from summer pasture.

To effectively plan facilities, you must consider components of your system; costs of materials and maintenance; the kind of materials to be used; jobs to be accomplished within the system; the number and kinds of animals to be handled; the length of time the animals will be controlled; water, shelter, and food requirements; and safety and environmental concerns.

Costs vary widely from one region to another and therefore costs throughout this handbook are comparative rather than specific.



Corral system components



Typical corral system

Space, water, and feeding requirements for each animal can be calculated from the following chart:

Space, Water, and Feeding Requirements

	Holding Space Requirements/Animal Ft^2	Feeding Space Requirements/Animal* Inches	Water Requirements** Gallons/day
Cattle			
Mature cows & bulls	20 - 25	26 - 30	12 - 15
Calves	10	18 - 22	8
Horses	80 - 100	26 - 30	12 - 15
Sheep			
Ewes & rams	15	16	1.5 (ewe/lamb pairs)
Lambs	6	12	

Use the above information to calculate needs for each type of livestock to be handled.

Type of Livestock (cattle, sheep, horses)	Present Maximum Number		Anticipated Additions		Space/Animal (From Above)		Total Space Needed
_____	_____	+	_____	x	_____	=	_____
_____	_____	+	_____	x	_____	=	_____
_____	_____	+	_____	x	_____	=	_____
_____	_____	+	_____	x	_____	=	_____

*All animals feed at once.

**The water requirements of each animal depend on the weight and condition of the animal, activity and stage of reproduction, and environmental factors.

Once you have determined the space needed, use that information to decide the number and kinds of facilities needed.

Determining Facility Needs

	Present	Future
Total Pen Area	_____	_____
Holding Pens	_____	_____
Sorting Pens	_____	_____
Loading Chutes	_____	_____
Working Chutes	_____	_____
Restraining Facilities	_____	_____
Scales	_____	_____
Pest Control Facilities	_____	_____
Watering Facilities	_____	_____
Feeding Facilities	_____	_____
Shelters	_____	_____

Material costs for livestock handling facilities vary widely from one area to another, but can be roughly estimated using the following rule of thumb:

Estimating Material Costs

Component	Wood		Prebuilt Metal		
Corrals & Working Chutes					
Gate (12 ft x 72 in)	1	multiplied by	2	=	$ _____
Panel (12 ft x 64 in)	1	multipled by	4	=	$ _____
Squeeze Chute	--		Metal Recommended	=	$ _____
Loading Chute					
Permanent	1	multiplied by	3.5	=	$ _____
Portable	--		Metal Recommended	=	$ _____
Cradles & Tables	--		Metal Recommended	=	$ _____

Corral Systems

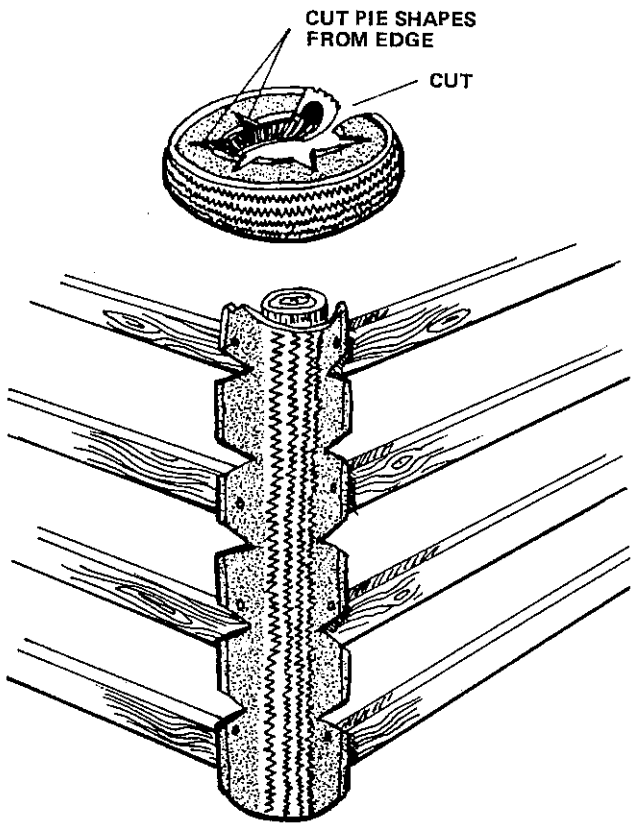
A corral system consists of pens, alleyways, fences, and gates that hold or move animals within the handling facility. A well-designed system depends on careful analysis of your current and anticipated needs.

Safety to both livestock and handlers must be considered. Sharp corners should be avoided or padded with old tires. Nail and bolt heads should be flush with rails. Rails should be cut flush with the posts to eliminate protruding ends. Low-hanging gate frames or wires can be hazardous to handlers on horseback, so allow at least 10 feet of clearance. Commercial panels will often have rounded corners, however, if the animal tries to go over the panel, it can catch a hoof at the intersection. A panel 64 inches high is acceptable, but a panel 66 inches high is recommended.

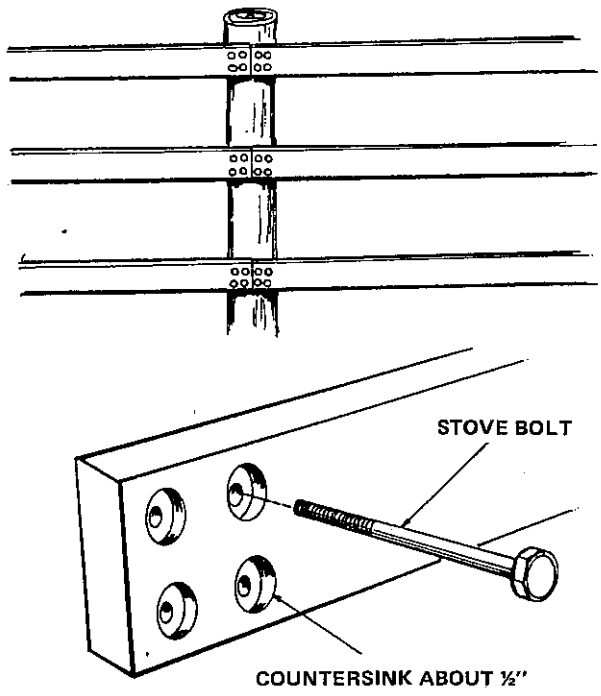
Construction materials are also important. Most corrals are made of wood posts and rails or from rough-cut lumber. Steel components for either permanent or temporary corrals can be purchased and set up easily. Purchasing costs are high, but the maintenance is low and they have a 30- to 40-year lifespan. Treated well-constructed wooden posts and gates can be expected to last roughly 15 to 20 years.

Costs will depend on whether materials are on hand or must be purchased. It may be more economical to contract construction of the facilities.

When you have decided on the kind and number of corrals you need, you must consider where to locate them. Locate the system conveniently to receive maximum use. A corral serving a community, for example, should be centrally located so livestock producers can easily trail or transport stock. A livestock association corral should be located as close to ranges as possible and on the route livestock travel between ranges and ranches.



Corners can be padded with tires



Recessed bolts prevent injuries

Select an area with space for expansion. Large clearings, open hilltops, or areas where trees can be cut are best. Provide room for loading and unloading and for parking vehicles. Allow sufficient room to turn trucks completely around; about ¼ acre should be adequate. Corrals should be accessible to all-weather roads.

Select a site with good drainage. A slope of 4 to 6 percent is usually adequate. Sand or gravel require less slope; clay requires more. Southern exposure dries faster. Use snow fences and diversion ditches to protect loading areas and access roads.

Corral site has room for expansion and turning trucks. Area also has good drainage and natural protection

Provide electricity for operating equipment and illuminating work areas. The expense in building a powerline to the site must be weighed against the convenience of the location. It may be wiser to locate the facility closer to the main powerline or to provide a portable auxillary power source.

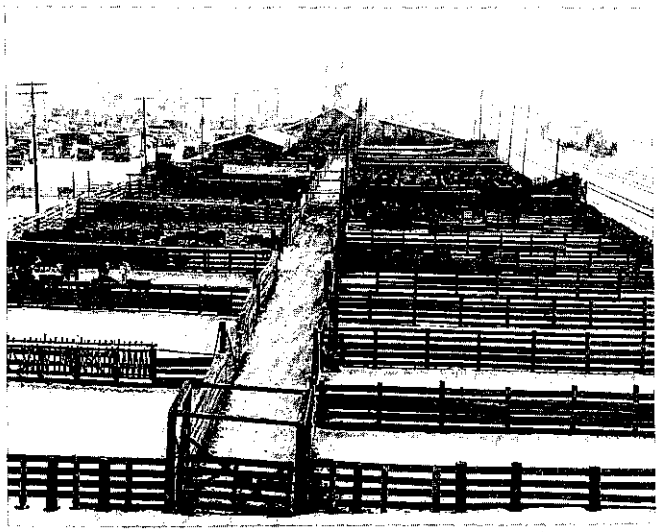
Take advantage of trees, buildings, or hills that serve as windbreaks. Trees can also shade livestock.

The site should minimize pollution. Place the corral system where prevailing winds will not carry odors directly past homes or public facilities. Manure from the corral system must not be allowed to flow into streams or onto roadways. Clean corrals when the manure gets 6 to 8 inches deep to prevent the possibility of foot diseases. Dispose of manure where it will not contaminate a water source. Cultivated fields or pastures work well.

Poor drainage—area drains into stream

Pens and Alleyways

The number of pens needed depends on the degree of separation required in sorting the livestock. Allow at least one pen in addition to those needed for holding sorted animals. More small pens give you greater flexibility than a few large pens.



Pens and alleyways in a community corral near a railroad

Holding pens confine animals for periods up to 3 to 4 months. The pens usually include feed and water facilities. Allow space for animals to lie down. A holding pen is usually at least 500 square feet.

Provide water. Automatic water dispensers are most convenient. Good drainage with a 4- to 6-percent slope or a ½-inch drop per foot is essential. Gates should give easy access to the working alley and crowding pens.

Sorting pens hold livestock for a few hours and are used to separate livestock into specific groups. A minimum of two sorting pens is needed for a working corral system. Each pen should be at least 300 square feet and hold 20 head of livestock. Gates should give easy access to the working alley and to the holding pen.

Crowding pens force animals into smaller work areas like loading or working chutes. Crowding pens should have a minimum area of 150 square feet or 1½ times the floor space of the largest truck to be loaded. Crowding pens narrow gradually toward the chute opening. The gate should open into the working chute, not into the crowding pen. Solid sides are preferred by some producers because animals can see less.

Alleyways are passageways between pens. Build alleys at least 12 feet wide to accomodate trucks and cleaning equipment and to allow livestock to move easily. Plan alleyways so livestock can be routed to the loading chute from any part of the handling facility. Have direct gate access to all pens from the alley. Gates along the alleyway should be 12 feet long and capable of swinging either way. Extra gates in alleyways can assist in sorting or forming additional pens. Alleyways should not occupy more than 20 percent of the total corral area unless you plan to also use them as pens.

Fences and Gates

A corral system can be no more dependable than its fences and gates. Quality materials and construction designs are more efficient and safe. Metal is longer lasting, but more expensive than wood. However, good construction practices can extend the life of a wooden fence. A well-constructed fence can be expected to last about 20 years. The following table compares life expectancy for various species.

Life Expectancy of Treated and Untreated Fence Posts

Kinds of Wood	Untreated Heartwood*	Pressure copper napthenate**	Treated Round Posts copper napthenate** Hot Soak	Treated Round Posts copper napthenate** Cold Soak	End Diffusion (Zinc chloride or chromated zinc chloride)	Double Diffusion (Copper sulfate and sodium flouride)	Salt Treatments (Osmose, tanalith and celcure)
	years	years	years	years	years	years	years
Osage Orange	25-30						
Red Cedar	15-25	20-25	20-25	10-20			
Black Locust	15-25						
Sassafras	10-15	20-25	15-20				
White Oak	5-10	20-30	15-30	10-20	8-9		
Blackjack Oak	5-10	15-25	10-20	10-20	8-9		
Cypress	5-10	20-30	15-30				
So. Pine	3-7	25-30	15-20	10-20	10	20-30***	25***
Sweetgum	3-6	20-30	20-30	10-20			
Hickory	2-6	15-20	10-15	10-15			
Red Oak	2-6	20-30	20-30	10-20	6		17***
Sycamore	2-6	20-25	15-25	10-20	8-9		
Yellow Poplar	2-6	20-25	15-25	10-20	8-9		
Cottonwood	2-6	15-20	10-15	5-10	5		
Willow	2-6	30	28-37	7-20	5		
Ponderosa Pine	4-14	35	30	18			
Lodgepole Pine	4-12	35	35	20			
Rocky Mt. Juniper	29						
Douglas Fir	7-12	20	25	2			
Aspen	7-12	20	25	20			

*Sapwood of all species rots readily in one to three years depending on local soil and weather conditions.
**Data based on an absorption of 6 pounds or more per cubic foot of wood with complete penetration of sapwood. All preservatives applied in an oil solution. Posts barked and seasoned before treatment.
***Water solution ¼ - 1 pound of dry salt per cubic foot of wood. Posts must be green when treated.

Prepared by the Coordinated Wood Preservation Council, an organization of southern agricultural colleges and experiment stations; the Forest Utilization Services of the Southern and Southeastern Forest Experiment Stations; and the Division of Forestry Relation, T.V.A. Supplemented with references as numbered. Data for Rocky Mountain area posts were obtained from Forest Products Laboratory USDA, Report 068.

Posts, rails, and other wood members contacting the ground should be treated with a preservative. Wood can be preserved by controlling the moisture content, using wood naturally resistent to the pests, or by chemicals. Mechanical barriers are sometimes used, but are usually ineffective. This handbook discusses chemical preservatives.

Sap wood and soft wood accept wood preservatives much better than heart wood or hard woods do. If possible, choose sap wood from a soft wood species for your wood components.

Wood preservatives fall into three catagories: creasote and creasote solutions, oil-based preservatives, and water-based preservatives. The following table shows the advantages and disadvantages of the three general types of preservatives.

Preservatives

Preservative Type	Advantages	Disadvantages
Creasote and Creasote Solutions	Toxic to wood-destroying fungi, insects, and some marine borers; low volatility; insoluable in water; easy to handle and apply.	Dark color; strong odor; oily, unpaintable surface, tendency to bleed or exude from the wood surface; should not be used in homes or other living areas because of toxic fumes.
Water-based	No hazard from fire or explosion; the surface is left clean, paintable, and free of objectionable odors; safe for interior use and treatment of playground equipment; leach resistent.	Unless re-dried after treatment, the wood is subject to warping and cracking; does not protect wood from excessive weathering.
Oil-based	Toxic to fungi, insects, and mold; can be dissolved in oils having a wide range of viscosity, vapor pressure, and color; low solubility; can be glued, depending on the dilutant or carrier; easy to handle and use.	Can leave an oily, unpaintable surface, depending on the carrier; some applications provide less physical protection to wood than creosote; should not be used in homes or other living areas because of toxic fumes; it is toxic and irritating to plants, animals, and humans.

There are two basic methods of applying wood preservative.

Pressure treating is the most common practice for commercial companies treating wood. Pressure treating offers the following advantages: a deeper and more uniform penetration; better control over retention; wood can be preconditioned in the chamber; is faster and more reliable; and it can comply with code regulations and engineered specifications.

However, once a treated member has been cut, insects and decay can enter through the non-protected area of the cut. For this reason, it is best to precut the members before treating.

Non-pressurized treatment is a cold soaking technique that can be used to treat wood members. When treated, wood should be peeled, seasoned, and unglazed. If wood is glazed, pound it with an incising hammer to allow the preservative to penetrate. Soak the poles until the preservative has evenly penetrated ½-inch into the wood. This may take from several hours to several days. Soak a sample pole and inspect cuttings at regular intervals to establish the time needed to treat the poles. A recipe for preservative is:

1 to 1½ cups boiled linseed oil

1 ounce melted parafin wax (Melt over a double burner only; do not melt over direct flame)

19 ounces copper-8-quinolinoate

Add enough solvent (mineral spirits, paint thinner, or turpentine) to make 1 gallon

A typical corral fence would require 25 to 30 gallons of preservative. Fill a 55-gallon barrel half full with preservative. Load posts or other wood to be treated into the barrel. If the preservative does not then fill the barrel, add solution to the top.

There are three major wood preservatives classified by the Environmental Protection Agency: creosote, inorganic arsenicals, and pentachlorophenol. Restricted use was based on toxicity due to exposure over a long period of time.

Exposure can come through handling and mixing the chemicals, entering pressure-treating cylinders, working around spraying or dipping operations, handling freshly treated wood, cleaning or servicing equipment, or disposing of waste preservatives.

Reducing the exposure received reduces the level or risk of toxicity. Exposure can be reduced by following the guidelines listed below:

1. Don't eat, drink or use tobacco products in the work area.

2. Wash hands often.

3. Remove gloves to handle paper work, phones, or equipment that other people may touch.

4. Eye protection, long-sleeved shirts, rubber gloves, long pants, respirators, and rubber or heavy boots should be worn when working with the preservative of freshly treated wood.

5. Wash clothes separately.

A single or short-term exposure of the three restricted preservatives can cause the following symptoms:

Creosote:

Can cause skin irritation; vapors and fumes are irritating to the eyes and respiratory tract; prolonged and repeated exposure may lead to dermatitis.

Pentachlorophenol:

Irritating to eyes, skin, and respiratory tract.

Ingestion of penta solutions, inhalation of concerntrated vapors, or excessive skin contact may lead to fever, headache, weakness, dizziness, nausea, and profuse sweating. In extreme cases, coordination loss and convulsion may occur. High levels of exposure can be fatal.

Prolonged exposure can lead to an acne-like skin condition or other skin disorders, and may cause damage to the liver, kidneys, or nervous system.

Inorganic arsenicals:

Exposure to high concentrations of arsenical compounds can cause nausea, headache, diarrhea and abdominal pain (if material was swallowed); extreme symptoms can progress to dizziness, muscle spasms, delirium, and convulsion.

Prolonged exposure can produce chronic, persistent symptoms of headache, abdominal distress, salivation, low-grade fever, and upper respiratory irritation.

Long term effects can include liver damage, loss of hair and fingernails, anemia and skin disorders.

In case of exposure, follow these procedures:

If skin has been exposed, first remove contaminated clothing. Immediately wash the affected areas with mild soap and water. Don't irritate the skin with vigorous scrubbing. Later, if you notice inflammed skin, redness, or itching in the affected area, consult a doctor.

In cases of eye contact, immediately flush the eyes with running water. Lift the upper and lower eyelids for complete irrigation and continue for fifteen minutes, then see a doctor.

If accidental inhalation has occurred, move the victim to fresh air and apply artificial respiration as needed. Get medical help immediately.

If chemical preservative has been swallowed, call medical help immediately:

*If creosote or penta was swallowed, first give one or two glasses of water, induce vomiting, then administer two tablespoons of 'USP Drug Grade' activated charcoal in water.

*If an arsenical chemical has been swallowed, drink large quantities of water, or milk if available. Get professional medical help immediately.

Never attempt to give anything by mouth to an unconscious person.

Never induce vomiting in an unconscious person.

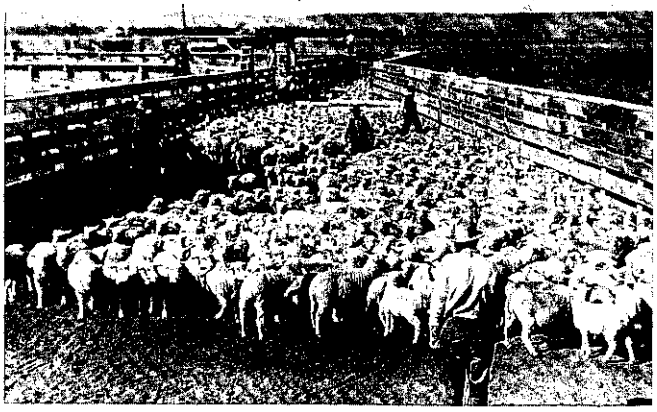
The product label and consumer data sheets supplied by the chemical companies also provide emergency treatment recommendations.

Use extreme care when using wood preservatives or wood treated with a preservative. When working with wood treated with one of the restricted preservatives, consult the Environmental Protection Agency or your County Extension Agent.

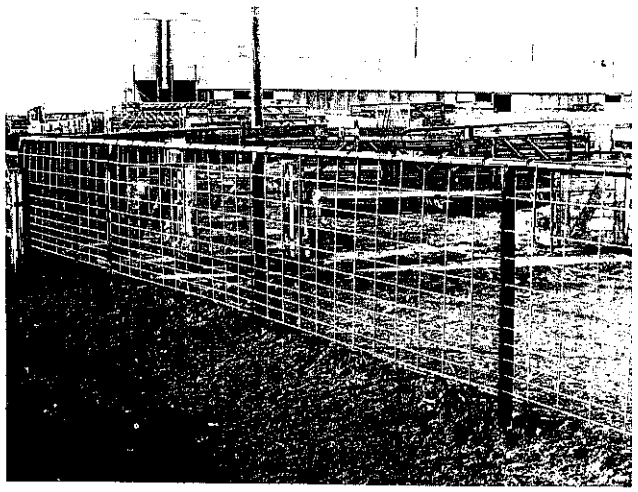
Set treated posts 2½ feet deep in heavy gravel soils and 4 feet deep in light clay. Posts should have a top diameter of 4 inches. Sound railroad ties make excellent corral posts. Space the posts 6 feet apart. The spacing can extend up to 10 feet if heavy posts and rails are used.

Fence rails are normally made of either rough-cut boards (2 inches x 5 inches for up to 6-foot post spacing; 2 inches x 8 inches for longer post spacing) or poles not less than 3 inches in diameter at the small end. Pole rails may be less expensive, particularly if a rancher has a nearby supply. Rough-cut board rails are easier to install, require less maintenance, and provide greater control of spacing between rails.

Fasten rails to posts with ½-inch bolts. Use U-bolts for extra strength, particularly if rails are butted together at a single post. Lag screws, nails, or tie wires are not as effective as bolts or U-bolts.

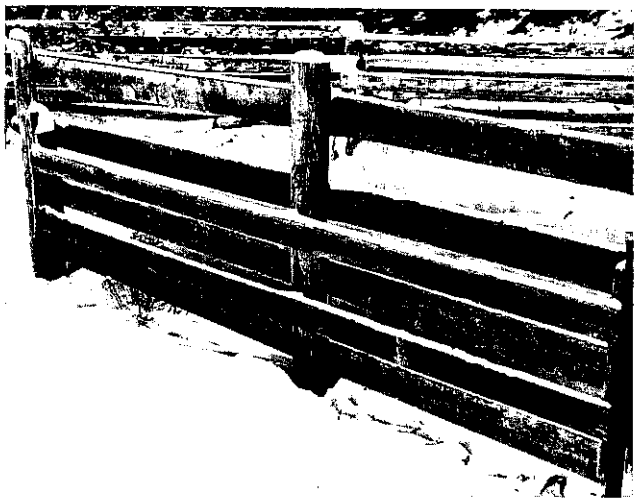


Wooden corrals are durable and inexpensive
Photo courtesy Montana Historical Society, Helena, MT



Metal corrals are safe and long-lasting

If cattle are worked on both sides of a fence, bolt a single guardrail 36 to 40 inches above the ground on the side of the posts opposite the main rail. Put the single rail on the side of the fence with the least pressure.



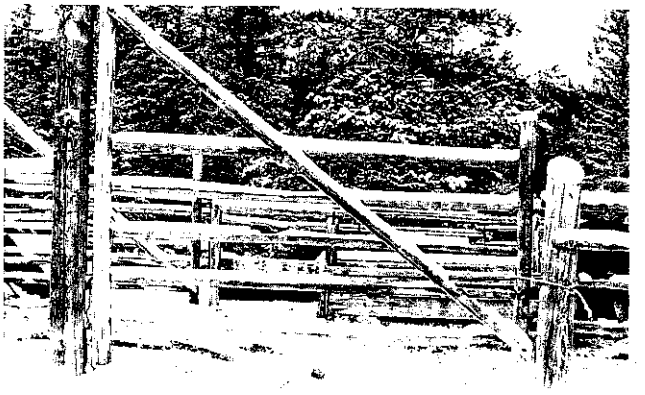
Guardrail allows livestock to be worked on both sides of fence

Corral gates must be strong enough to withstand pressure from crowding livestock. Gates must swing without binding, resist sagging, and open freely despite accumulated dirt or manure. Make gates the same height as the fence. One less bottom rail often is used on gates to allow extra clearance, but do not leave more than 12 inches or stock may crawl under.

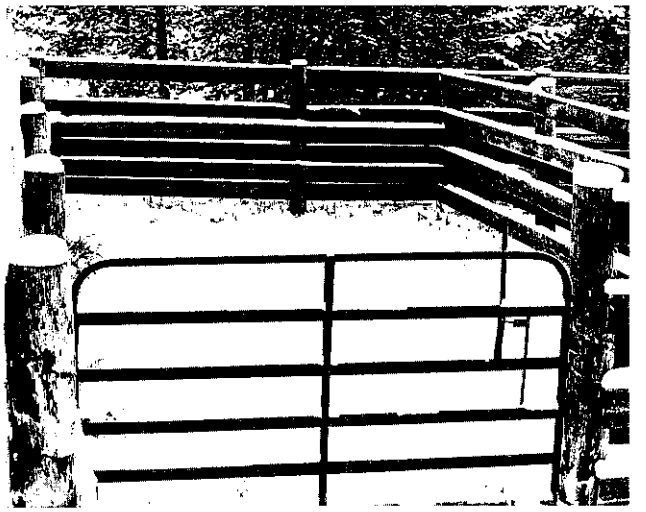
The length of gates should be coordinated with the width of alleyways or crowding pens. Gates 10 to 12 feet long are most common for alleyways. These gates must have a substantial lock and catch to prevent the latch from breaking. Gate posts should have 10-inch diameter butts and be set at least 4 feet deep. Overhead stringers between posts increase rigidity. If stringers are installed, allow at least 10 feet of clearance.

Metal corral gates withstand weather and abuse better than wood. They are easier to operate and install and sag less as well.

Well-constructed gates resist sagging, severe weather, and heavy livestock pressure

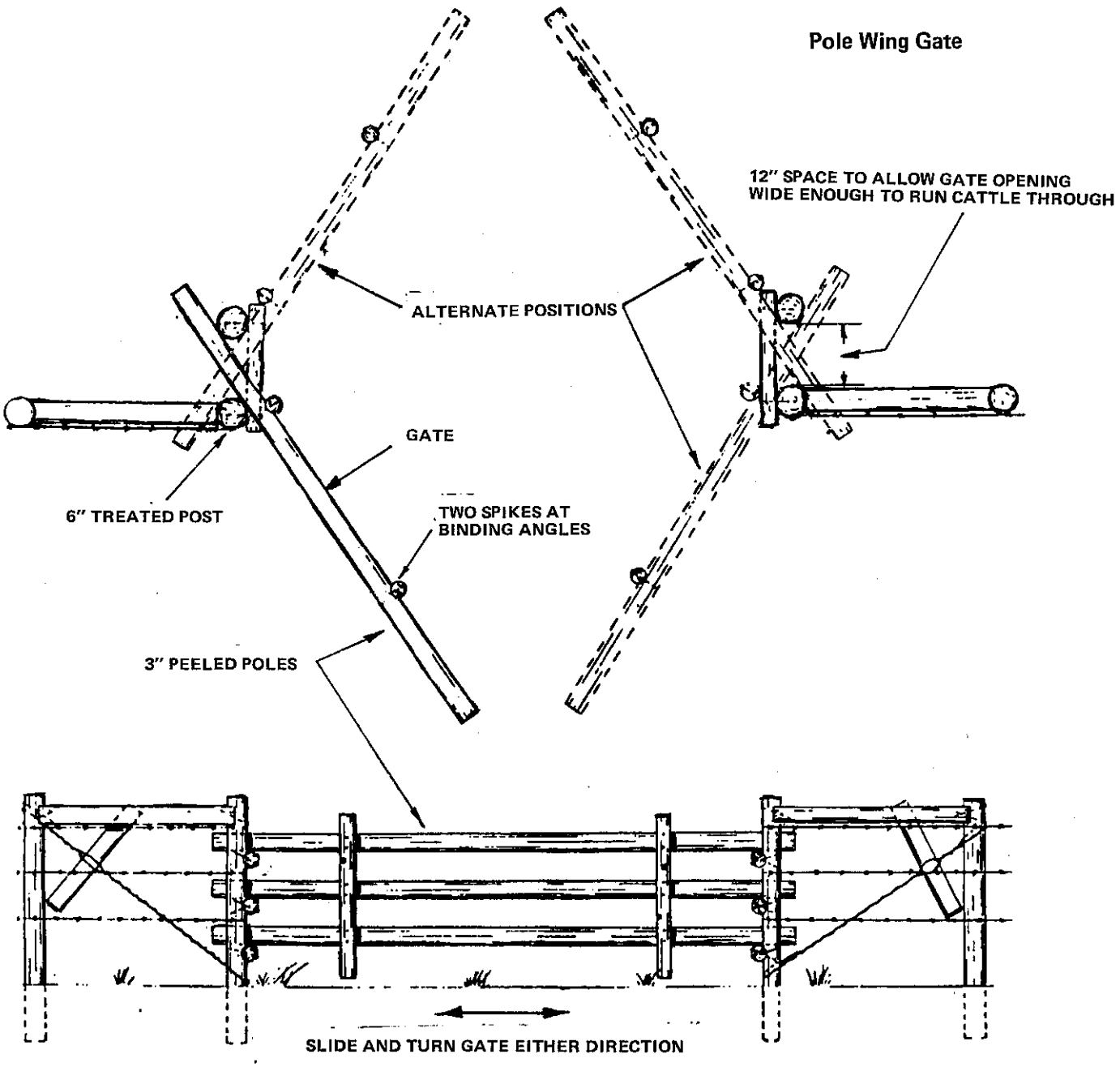


Coordinate gates with pens and alleyways



Metal gates are easy to install

Pole wing gates that allow a single rider to push livestock through can be constructed at gate intersections of fence lines and corral systems or in pasture or boundary fences. The gate swings open to create a working wing to funnel livestock. It can be constructed in any kind of fence from accessible material. Poles should have a top diameter of not less than 3 inches. The brace posts should be 6 inches and be pressure-treated by a commercial treatment plant.



Pole-wing gate

Restraining Facilities

Restraining facilities confine or immobilize livestock for such tasks as transporting, doctoring, or branding. These facilities include loading, working, and squeeze chutes, as well as cradles and tables. Any restraining device must be: dependable; require little or no maintenance; allow easy access for treatments; minimize injury to the animal and the handler; and provide an easy and fast flow of animals.

Not all handling facilities will require restraining facilities. For example, if a handling facility will only be used for sorting or holding animals, restraining facilities are not needed. But even if you decide that restraining facilities are not needed, provide adequate space for expansion. Cradles, tables, and squeeze chutes will each require about 400 square feet of room.

Restraining facilities should be located within the handling facility with easy access from pens and alleyways.

It is more economical to purchase high quality livestock restraining equipment than to build your own. Metal restraining facilities last longer than wood and commercial products are more efficient than home-built facilities. Restraining facilities can be portable or permanent. Portable restraining facilities are more economical since they can be moved to various handling facilities.

Restraining facilities are hazardous for both animals and handlers. Sturdy well-designed systems help prevent accidents. Avoid protruding handles. Pad corners with tires or any materials that will cover dangerous ends. If a part becomes worn or broken, fix it or replace it immediately.

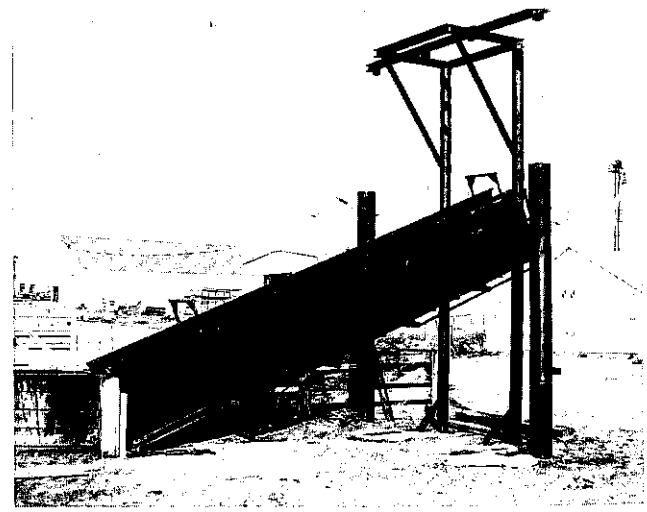
Good, sound equipment can be expected to last 30 to 40 years.

Loading Chutes

A loading chute connects a corral with vehicles transporting the livestock. It should be located with access to all the components of the corral system and to trucks or trailers transporting the livestock. You will probably need only one loading chute in your corral system.

Plan the loading chute so livestock can be sorted through alleyways from any part of the handling facility. Vehicles need fast, firm access to livestock even during inclement weather. Allow enough space for vehicles to enter and turn easily. A quarter-of-an-acre should be sufficient. It may be necessary to install snow fences or diversion fences to keep the area around the loading chute dry and accessible.

The loading chute ramp should have a safe, gradual slope. The chute should not be shorter than 10 feet; many producers prefer chutes up to 16 feet long. If the ramp is too short, the pitch will be too steep and livestock will resist climbing the ramp. If natural ground slope exists, it is often possible to use a square bank for loading.



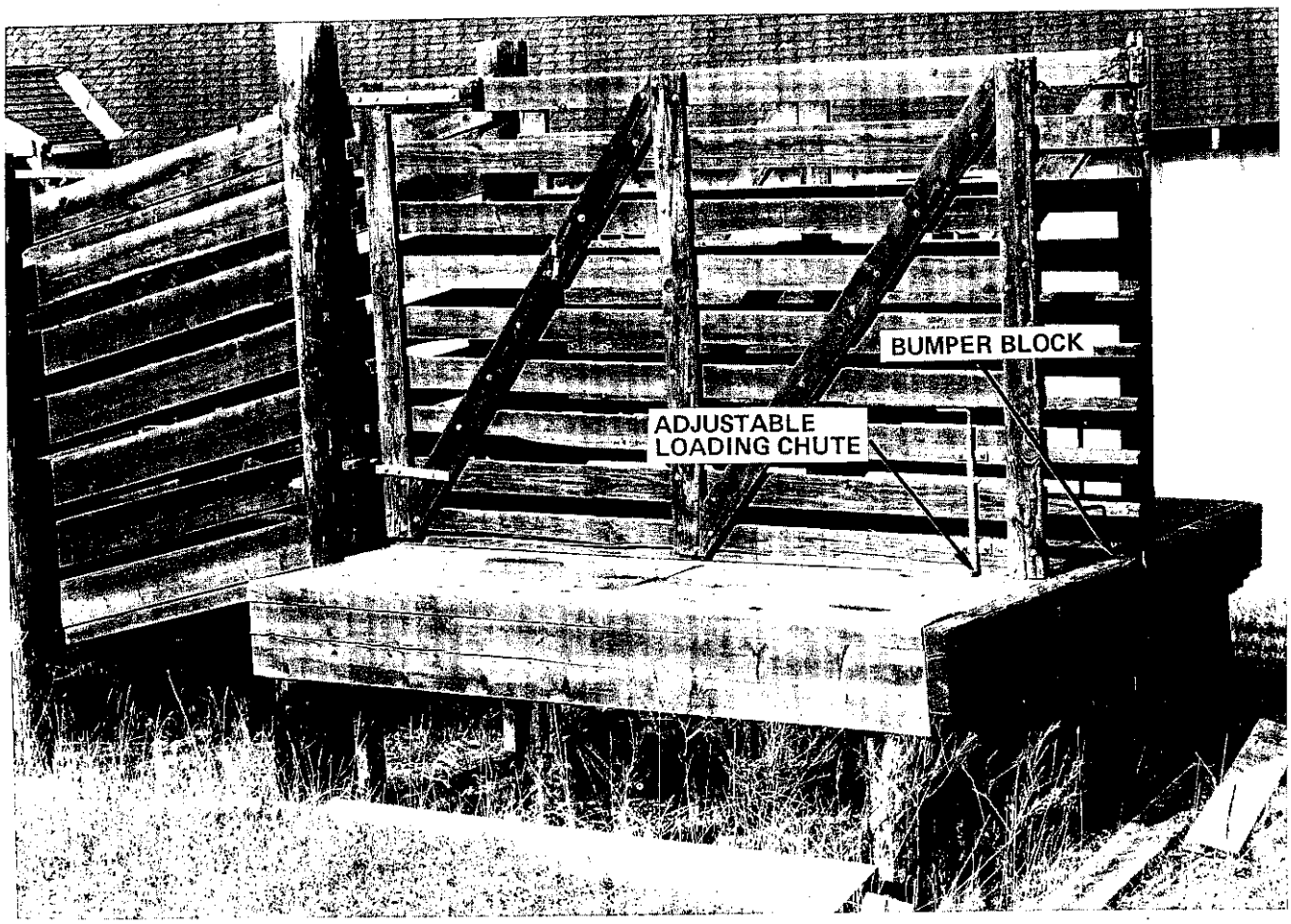
Adjustable loading ramp

A level platform at the top of the ramp reduces injuries while animals move from the chute into the truck or trailer. Platforms should be at least 5 feet long and can vary from 30 to 50 inches high to accomodate various-sized trucks. Adjustable chutes make loading safer. Most commercial chutes can be adjusted. Fixed-height chutes should be 46 inches high.

Most loading chutes are approximately 32 inches wide. Narrow chutes discourage turning and jamming. Wider chutes, up to 60 inches, allow faster loading into large commercial trucks. However, they cost more to build and allow livestock to jam if the truck doorway is narrower than the chute. Chutes can be adjusted for width. Use hinges to attach side boards at the back of the chute. This will allow the side of the chute to swing. Put a latch pin on the free-swinging end and holes in the floor of the chute to drop the pin into.

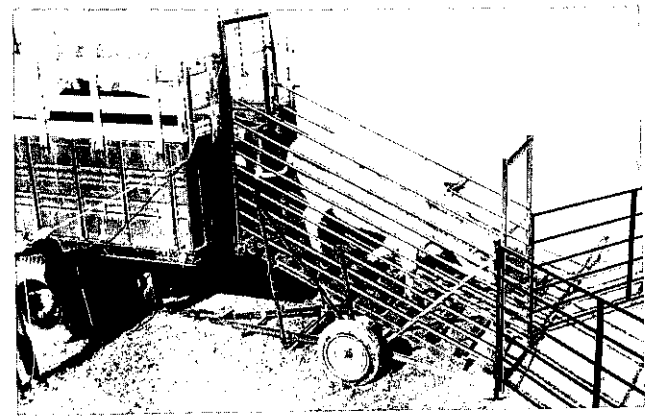
A blocking gate or an insert bar along the ramp can prevent livestock from backing out. This is a pipe that shoves through a hole in the side of the chute to allow you to stop cattle.

When backing a vehicle up to the loading chute a bumper block should be installed to stop the vehicle. In permanent installations, the bumper block should be reinforced 10-inch thick concrete. However, a bumper block of heavy timber will last for years.

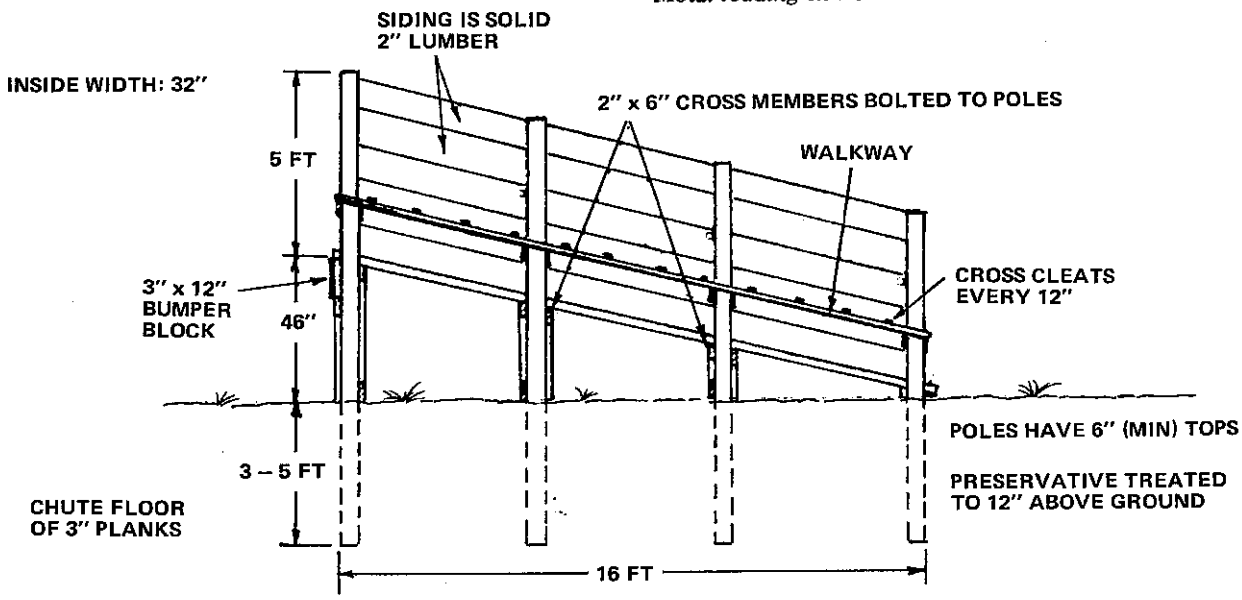


Adjustable loading chute

Commercial metal chutes are roughly 3½ times more expensive than wood, but are recommended. Loading chutes should be constructed of posts with 6-inch diameter tops. Posts should be set 3 feet deep in gravel soils and 5 feet deep in light clay soils. Posts should be long enough to provide 5-foot high sides. Post spacing should not exceed 6 feet. Use rough, 3-inch planks to form the ramp base. Cross members between the chute posts support the planks. Use cleats on the ramp to minimize slipping. Do not use gravel as a ramp base unless the ramp is nearly level.



Metal loading chute



A loading chute needs to be sturdy and provide positive control. Chutes are constructed of the following materials:

A walkway along one side of the chute should be 15 to 20 inches wide and about 20 inches higher than the floor of the chute.

Poles, 6 in min. tops, preservative treated
- 2 - 14 ft
- 4 - 12 ft
- 2 - 10 ft

Supporting material
- 82 lineal ft of 2 in x 6 in

Chute floor:
- 3 - 3 in x 12 in - 18 ft long
- 50 lineal ft of 2 in x 4 in for cleats

Bumper block:
- 1 - 3 in x 12 in - 4 ft long

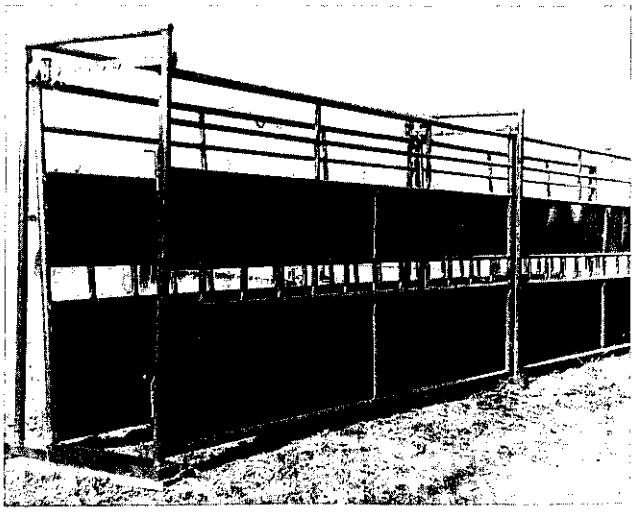
Chute sides:
- 350 board ft of 2 in material

Walkway:
- 2 - 2 in x 8 in - 18 ft long
- 20 lineal ft of 1 in x 2 in for cleats

Bolts:
- 16 - ½ in x 12 in machine bolts, washers for each end
- 8 - ½ in x 10 in machine bolts, washers for each end

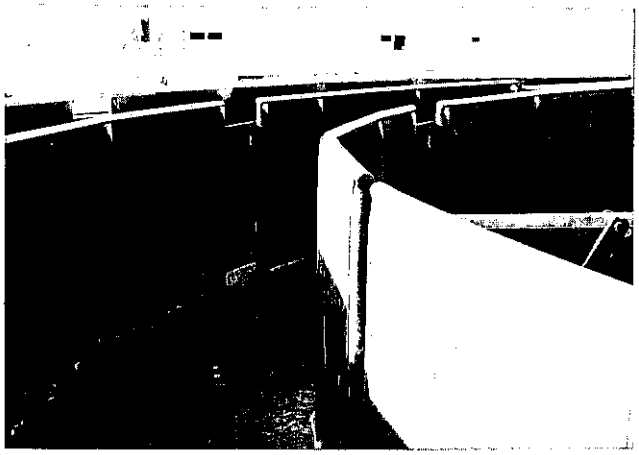
Working Chutes

Working chutes confine animals in single file for such tasks as sorting, doctoring, weighing, or branding. They connect with pens or alleyways to funnel animals to loading chutes, tables and cradles, squeeze chutes, or pesticide facilities. Working chutes for handling large numbers of livestock should accomodate at least 12 animals single file at one time. A chute 40 to 50 feet long is usually satisfactory. The working chute should be 28 inches wide. It is normally constructed as a permanent part of the corral system. Commercial metal chutes are available. They cost roughly four times as much as wooden ones. Normally, only one working chute is needed for each corral system.



Metal working chute

Generally livestock will work easier in a curved chute with about a 40-foot radius. Animals are sometimes frightened if they can't see an opening. Solid-sided, straight chutes are satisfactory if the animals can see the opening at the headgate.

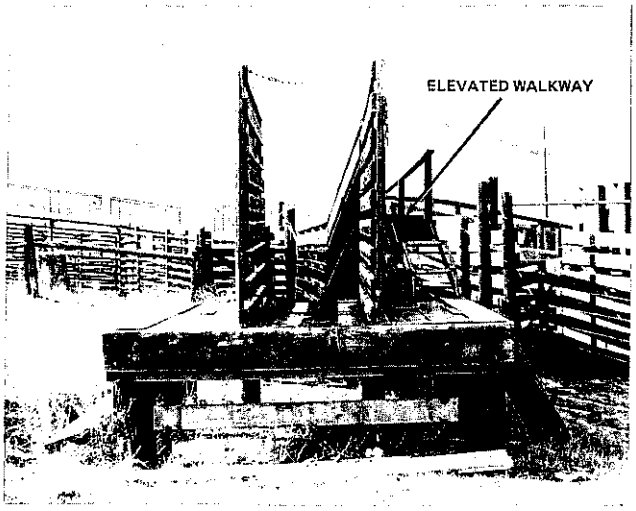


Curved chutes are particularly effective for handling sheep

A rough concrete slab, gravel, or a cinder floor reduces mud. Removing manure is easier with an 8-inch opening along the bottom on each side. Solid 2-inch boards above this bottom opening will reduce accidents and encourage the smooth flow of animals through the chute. A small opening cut 24 inches high through the side boards will allow rods or pipes to be inserted to block livestock.

Avoid construction that allows animals to gain footholds on the sides of the chutes. Pole rails, widely spaced board rails, or chute sides that slope out more than 2 inches per foot of height are not acceptable.

An elevated walkway along one side of the chute allows crowding and inspecting. For a curved chute, this walkway should be on the inside of the curve.



An elevated walkway

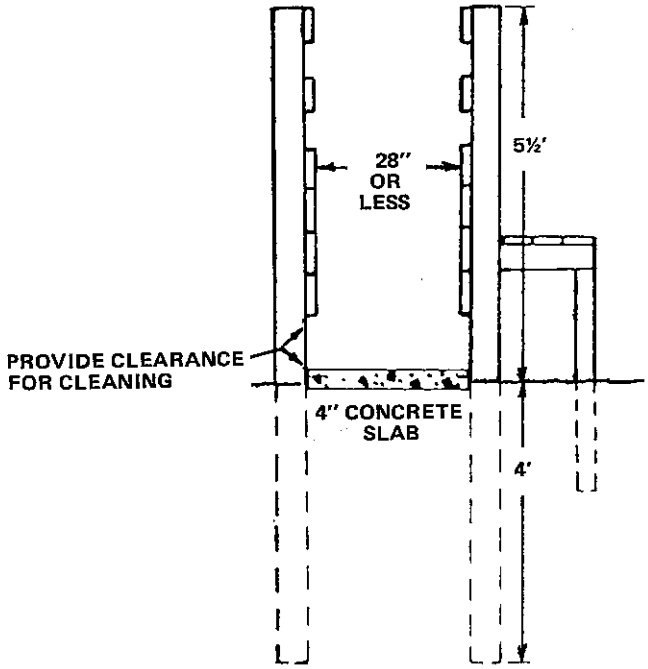
Overhead cross-members between posts are not recommended. Chute posts should have at least 5-inch diameter tops. Treat posts with preservative to 12 inches above the ground. Pole tops should be at least 5 feet above the floor of the chute.

Cutting gates can be placed on one or both sides of the working chute. These gates can direct livestock into sorting pens or into dipping vats, scales, or tables. A door may be located a short distance behind the squeeze chute for veterinarian access. This door should open inward to block the working chute and hold back other livestock.

Space posts at 6-foot intervals and plant them in the ground at depths varying from 2½ feet in heavy gravel soil to 4 feet in light clay soil.

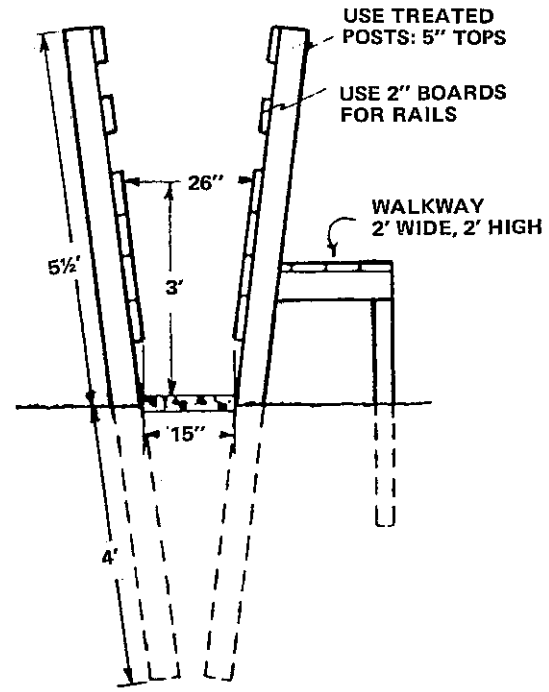
Working chutes can be constructed in several ways:

Straight-sided chutes are easiest to construct. Straight sides deter animals from climbing up and accomodate cutting gates. A chute with enough width to handle mature animals allows young animals to turn around. Drop sides can be inserted in the straight-sided chute to handle young animals. Parallel sides should be approximately 28 inches apart for large mature animals, closer for smaller livestock.



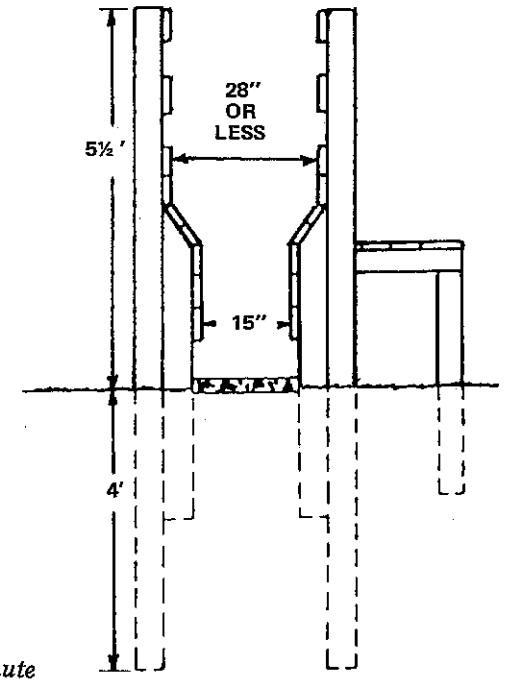
Straight-sided working chute

V-chutes accommodate animals of different sizes and animals with horns. However, if sides are sloped with more than a 2-inch spread per foot of rise, or if the sides are constructed to provide footholds, animals will be able to climb and fall. V-chutes should be approximately 20 inches wide at the floor and 26 inches wide 3 feet above the floor.



V-chute

Y-chutes accommodate both large and young animals, but they are difficult and expensive to build. Animals can gain footholds on the sloping part of the chute, which allows them to turn around and bunch up or possibly fall. The bottom portion of the straight sides should be built 24 inches high and 15 inches apart. Both sides of the chute slope out to a width of about 28 inches. The entire chute should be 5½ feet high.

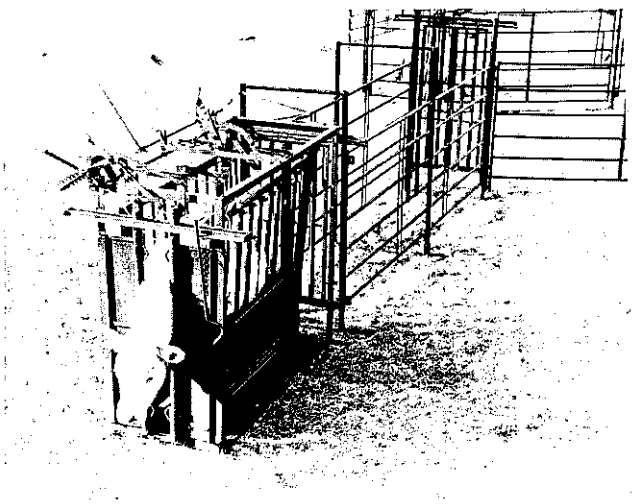


Y-chute

Adjustable chutes are ideal for handling livestock of different sizes, but they are considerably more expensive and difficult to build and maintain. Also, they are slow and cumbersome to manipulate if handling groups of mixed livestock.

Squeeze Chutes

Squeeze chutes are used to immobilize an animal while the animal remains standing. A squeeze chute may have any or all of the following features: (1) adjustable width at base, (2) blocking and releasing mechanisms for controlling squeeze pressure, (3) leg restrainers, (4) removable or swing-away panels for access, (5) horizontal and vertical adjustments on the headgate, (6) front-opening exit, (7) side-opening exit, (8) chin block and nose snubber, (9) rear blocking. Normally one squeeze chute per handling facility is sufficient



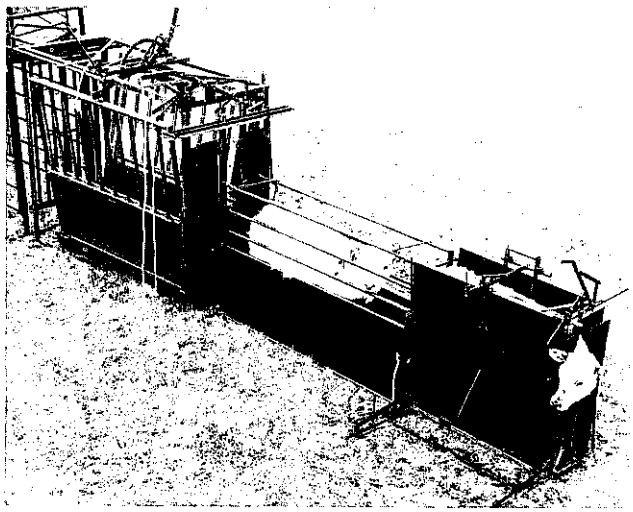
Squeeze chute

Squeeze chutes can be made of wood, but commercial metal squeeze chutes are recommended. Locate the chute at the end of the working chute where stock can be taken one at a time. If a squeeze chute and a cradle or table are both used in a single system, divert the livestock to one or the other through a cutting door in the working chute. This will enable the handler to sort the livestock in the working chute to the desired restraining facility.

Cradles and Tables

Cradles and tables effectively restrain the animals in a prone position and offer a high degree of safety to both the animals and the operator. This enables the handler to work on the livestock in a convenient position. They are especially helpful in working with calves and bulls. Tilt tables have replaced crude, cumbersome stocks as the best means of performing operations requiring complete restraint.

Tables and cradles can be made of wood, but commercially made metal ones are recommended. Locate them at the end of the working chute where livestock can be sorted into them conveniently. A cutting door can divert animals to these restraining facilities. Good sturdy metal tables and cradles can be expected to last up to 40 years. It is important to replace worn or broken parts to insure safety to handlers and animals.



Calf table

Miscellaneous Facilities

Pest Control

Pesticide facilities include dipping vats, spray pens, and dusting alleys. These facilities are used to apply pesticides to livestock. Pesticide facilities were designed to treat large numbers of animals but such facilities are almost obsolete because they are too hazardous and too expensive.

Special care must be taken when dealing with large quantities of pesticides. The environment can easily be contaminated if pesticide is allowed to leak or spill, and workers can be endangered by improper handling. Modern methods have proved to be safer and less expensive.

Pour-on insecticides are applied directly to the back of each animal as it passes through a working chute.

Ear tag insecticides are placed directly in the ear of each animal. Ear tags are normally applied in a squeeze chute or a calf table where the animal's head can be controlled.

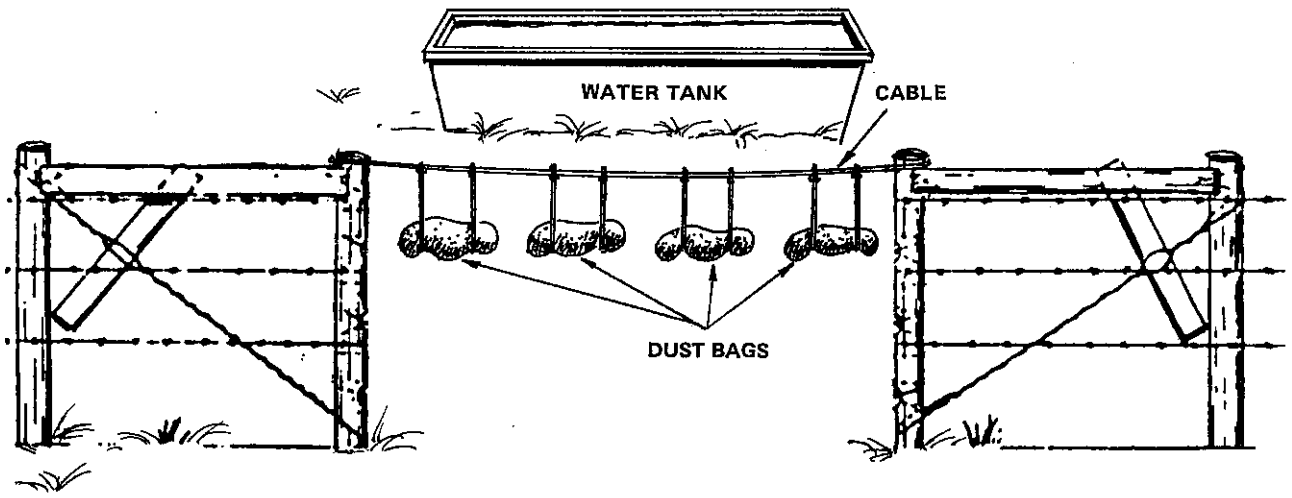
Injectable insecticides are administered through injection into the animal to control blood-sucking parasites. Under current law, these injections must be administered by a veterinarian.

Low-hanging dust bags are used to apply a pesticide each time the animal comes into an area for feed or water. The bag is hung low enough that the animal contacts the bag with its back and the pesticide is applied. The area must be fenced to control movement past the duster.

All these methods reduce the exposure of the applicator to the pesticide. To further reduce exposure the applicator should wear rubber gloves, goggles, particle mask, long pants, and long-sleeved shirt. Insecticide or pesticide on the skin should be washed off.

The newer systems have become more economical. Expensive facilities and the large amounts of pesticide are no longer required and application has become less labor intensive.

Consult pesticide dealers in your area or your county or state extension agency before using pesticides or insecticides.



Pesticide-filled dust bags

Back Rubbers

Back rubbers help control flies, grubs, or other insects. If uncontrolled, insects can cause reduced weight gains, infectious sores, or other health-related problems. Back rubbers can either be purchased or home-made. Either type can work well if properly designed and maintained. Home-made back rubbers are less expensive, but they usually are not as well designed and require more maintenance than commercial rubbers. Commercial rubbers have reservoirs that automatically feed insecticide to targeted areas on the animal. This reduces wasted insecticide and reduces the risk of contaminating the ground near the back rubber. A home-made rubber that allows cattle to treat all parts of their bodies is shown below. To make it, place two posts in the ground 15 to 20 feet apart. Cemented in steel posts are the most preferred but sturdy wooden posts will work well. These wooden posts should have a minimum top diameter of 6 inches. Fasten a chain or cable made of two or three strands of barbed wire, 4 feet high, to each post. Allow the chain or cable to sag to within 18 inches of the ground at the center. Wrap the chain or cable and any brace wires with three or four thicknesses of burlap. Tie this securely with binder twine. Saturate the sacks every few days with a good insecticide.

Again, commercial back rubbers are preferred. They are safer and more efficient. Do not place back rubbers near feed or water.

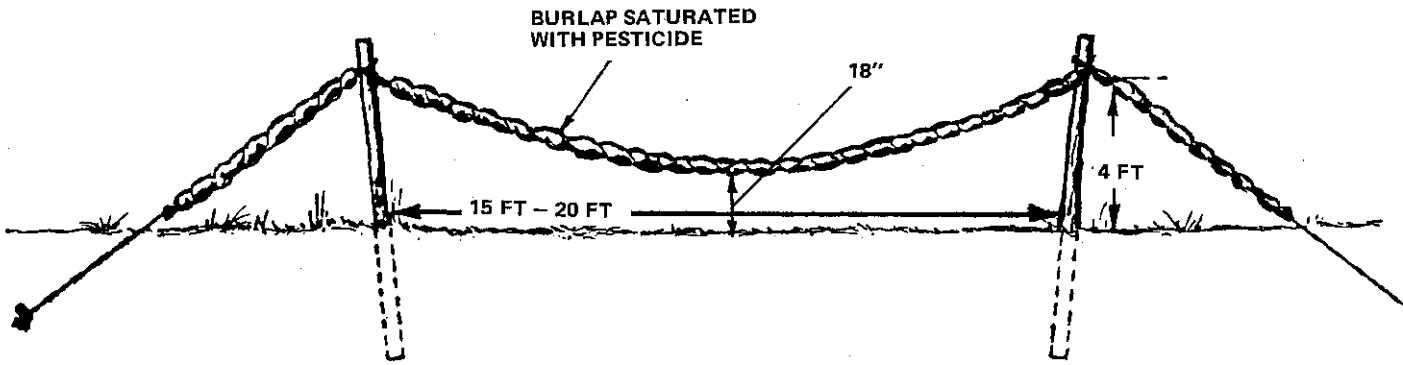
Scales

The scales described here are mechanical or electrical devices to weigh livestock, trucks, or feed. Scales incorporated into a corral system:

1. Provide accurate and reliable sale weights for marketing.
2. Provide records for selecting herd replacements to improve herds.
3. Measure rate of weight gain during winter feeding or summer grazing.
4. Determine weight loss from handling and shipping.
5. Provide weighing service for hay or grain producers.

In most cases, one scale will be sufficient. In very large operations where several hundred livestock are weighed in a short period of time, two or more scales may be used.

Scales come in a variety of sizes and capacities suitable for livestock producers. A single animal scale is the smallest and weighs one animal at a time. These scales are best used in conjunction with a squeeze chute or a working chute. Some single-animal scales are designed so that animals not to be weighed can still walk across the scale surface and not damage the scale. Single-animal scales are very convenient, but are too time-consuming to weigh large numbers of livestock.



Back rubber

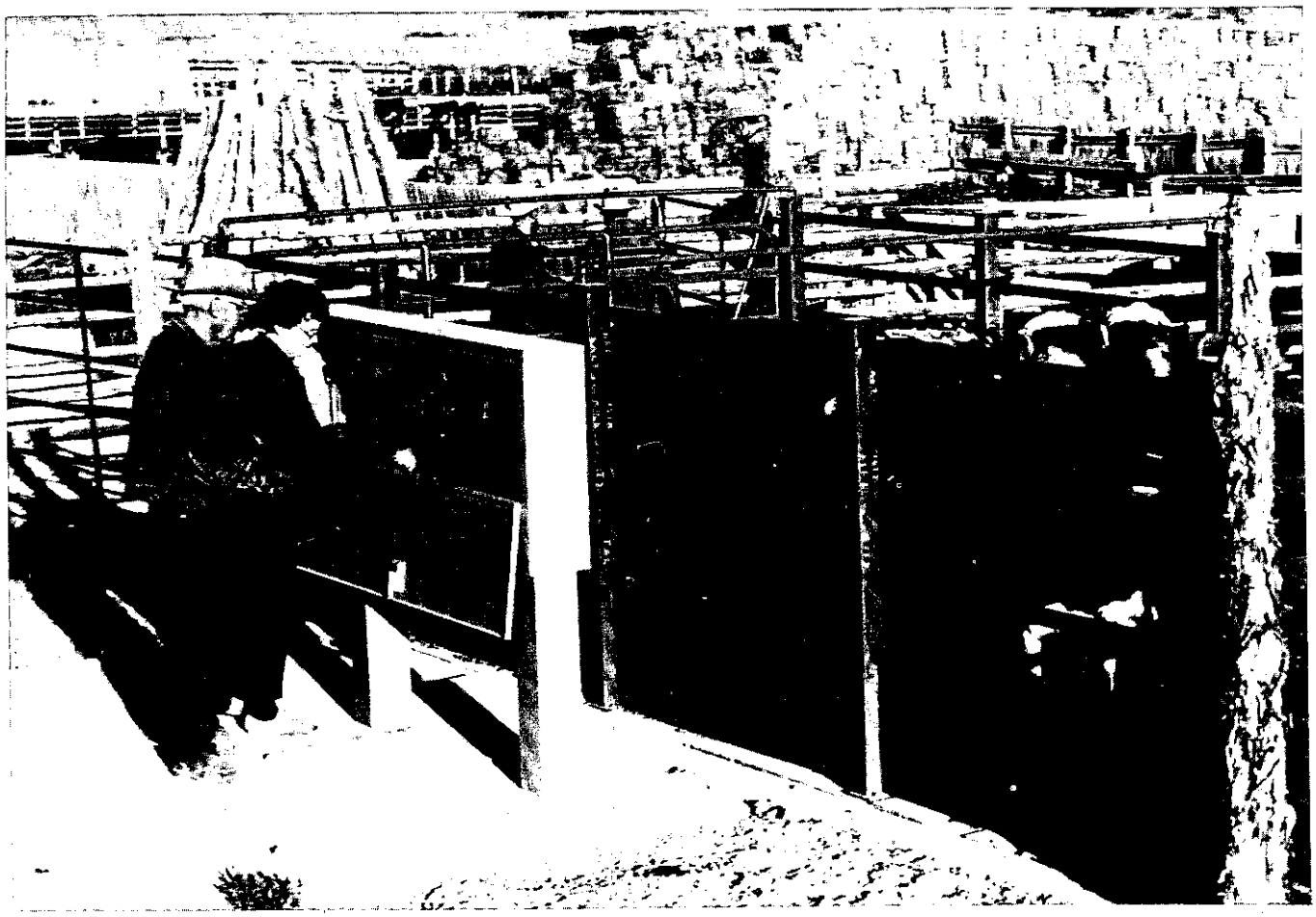
Pen-type scales are designed to handle approximately 6 to 20 animals. These scales do handle animals faster than single animal scales but do not fit into the working chutes of a handling facility as well.

Truck scales are designed to weigh entire truck-loads of livestock or feed. These scales have the largest capacity, but offer the lowest flexibility, and they require the greatest amount of room to operate.

A single animal scale installed into a working chute or squeeze chute requires only the space used by the working or squeeze chute. A pen-type scale will require enough room to install and operate the scale, and an alleyway to and from the scale itself. A truck scale requires the most room and will depend on the length of the scale. A straight approach at least half the distance of the scale bed is required on both ends of the scale.

Scales are delicate instruments that require a good base. For this reason, it is important to put the scale in a well-drained area with good support. Scales must be installed to the manufacturer's specifications. The purchaser can install the facility, a contractor can install the scale, or the vendor can handle installation. Scales used for legal measure must be installed to the National Bureau of Standards Handbook 44 specifications and must be inspected by the State Department of Weights and Measures. The vendor of the scale should be able to provide this information and contact the appropriate state officials.

Regular maintenance of a scale is imperative. Periodic inspection by the state is required. The underside of the scale should be periodically cleaned to prevent the obstruction of the working mechanisms. Both debris and snow should be removed. In a scale pit, the sump should be checked regularly to prevent any back water from damaging

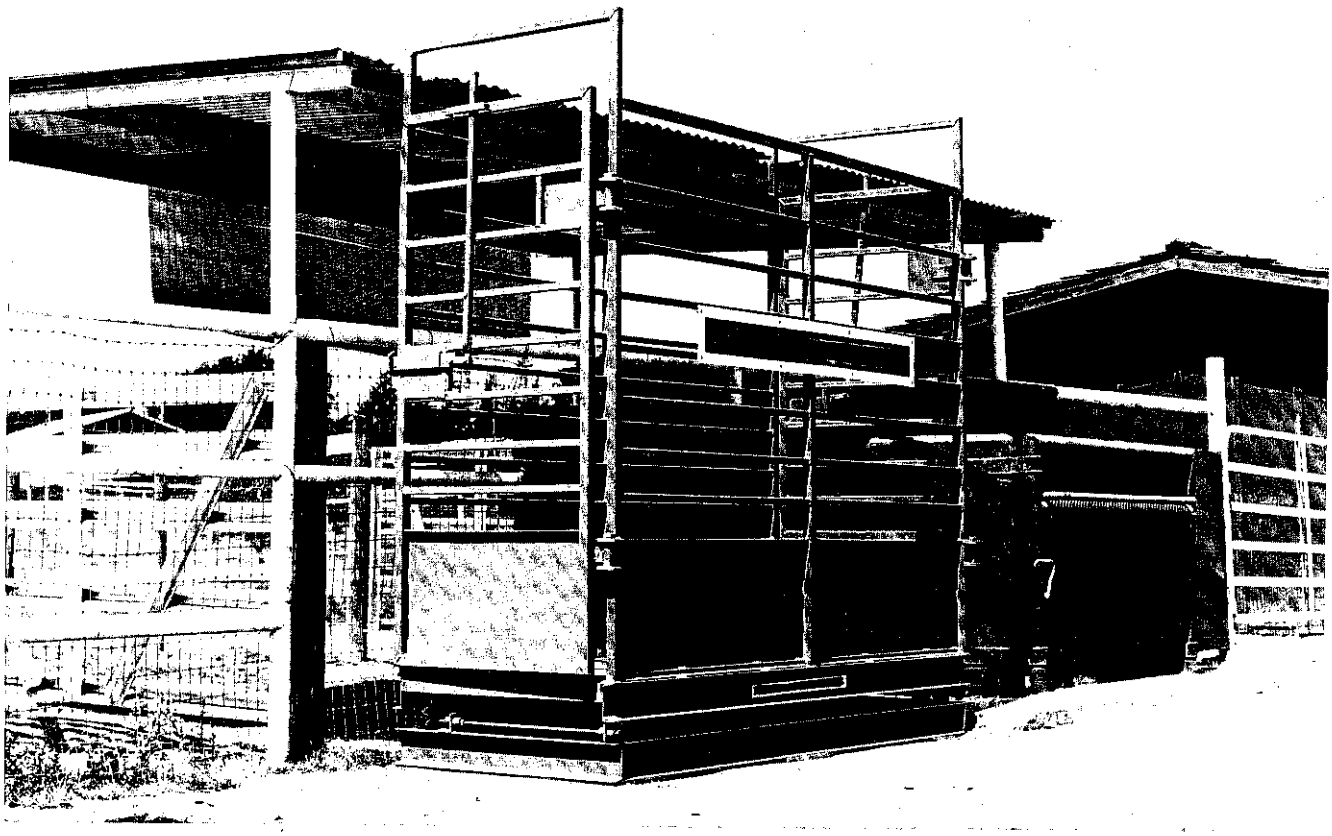


Pen-type scale

the scale. Paint prevents components from corroding and deteriorating. Instruments should always be protected from any extraneous material. By regular maintenance, a scale can be expected to last 20 years.

Scales vary greatly in price depending on the size. A small single animal scale will cost approximately $3,500 and a pen-type scale can be as much as $20,000. Truck scales are more expensive yet and are more expensive to install.

It is very important to consult the manufacturer when purchasing and installing a livestock scale. They can provide the required installation and regulation information to insure the scale is installed legally and correctly.



Individual animal scale

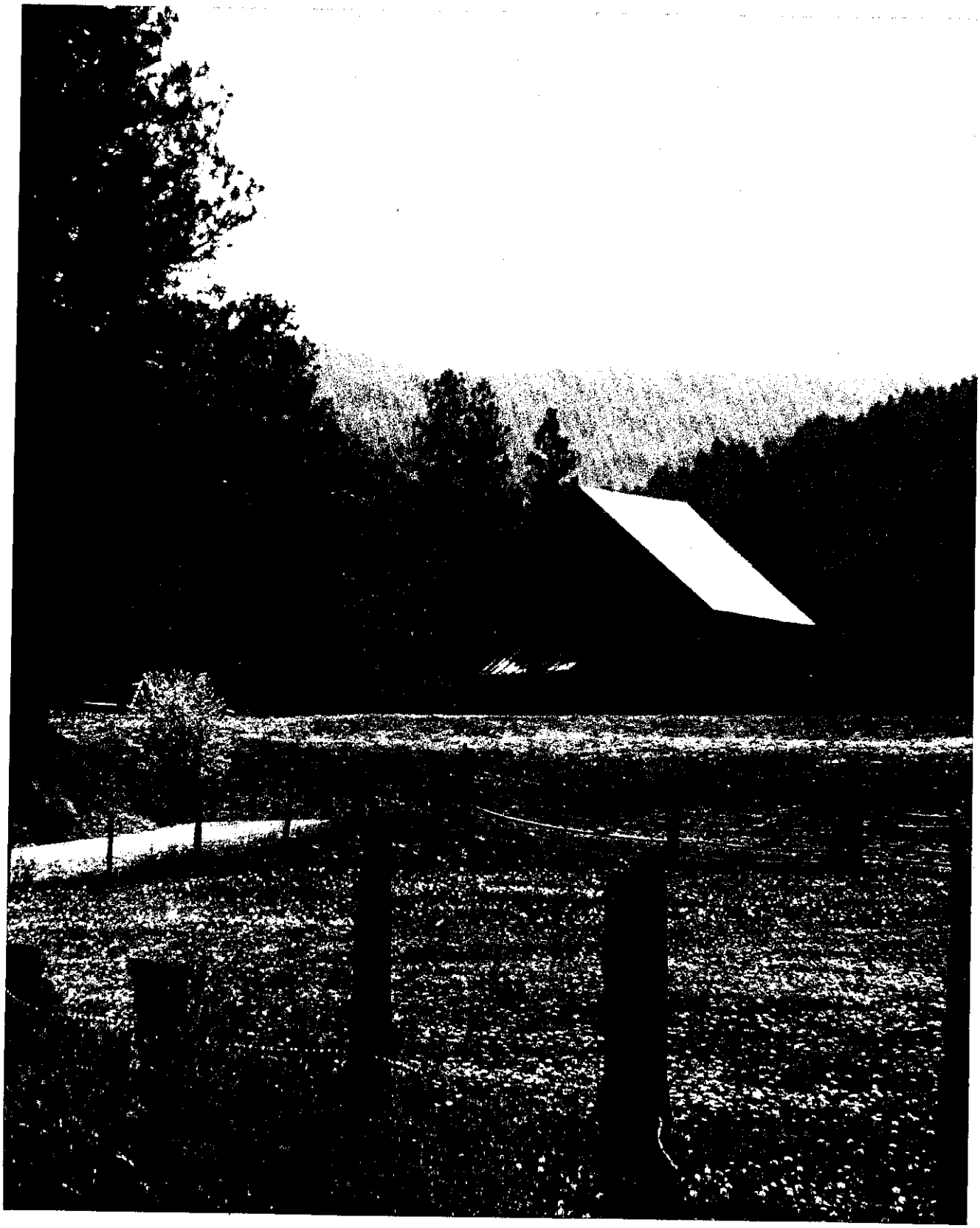


Photo courtesy Jean L. King, Missoula, MT

Sheltering Facilities

Shelters protect animals from extreme temperatures. When temperatures drop below 32°F or soar above 90°F, shelter should be provided. Harsh weather is especially hard on young animals, and since calving and lambing is often during cold weather, it is especially important to provide shelter. Newborn animals are extremely susceptible to weather-related illnesses.

For protection from both the cold and wind, a shed is needed. Sun shades or windbreaks are cheaper to build than sheds and are adequate in climates that are not threatened by cold.

Shelters should not be placed in low areas where runoff will collect or snow can drift in. It is most efficient to design and build your own shelters. A contractor can build or design the shelter, but it is more expensive. Shelters are permanent structures that if designed and built well, will last 30 to 40 years.

Manure will accumulate in or around these shelters, so they should not be built where runoff will pollute streams or surface water. Construct shelters so equipment can get in to remove the manure.

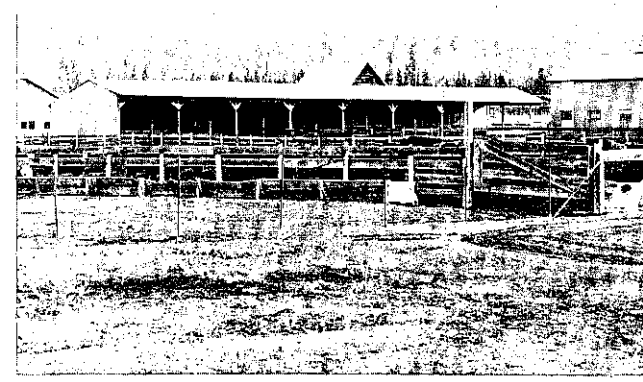
Sheds

Use sheds or buildings to protect livestock in cold, humid climates with frequent winter rains. Protection from snow is not as imperative as from the cold and damp. When temperatures are below freezing with humidities above 30 to 40 percent, shelter should be provided. In warmer areas or where humidity is low, natural shelters such as trees, brush, or hills are usually sufficient for livestock. Beef cattle should not be shut in during winter. Shed space should be about 30 square feet per cow, 20 per calf and yearling, and 30 per feeder. Horses need 150 to 200 square feet per animal, sheep need 15 square feet per mature ewe or ram and 6 square feet per lamb.

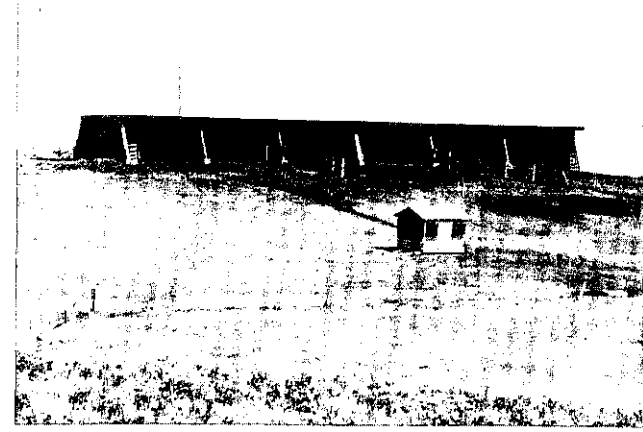
A shed located on a well-drained site that has a southern exposure provides satisfactory shelter for livestock in most climates.

Sheds can be built in a number of ways including pole construction, regular framed construction, or metal. Treated poles offer some advantages over other types of construction: (1) pole sheds are simple, fast, and inexpensive to build; (2) no large or continuous foundation is required; (3) they can be built on a slope so little site preparation is required; (4) pole buildings can be built in segments and added to as need arises or funds become available; (5) since poles support the roof, walls can be left open for easy access or ventilation; (6) pole sheds generally withstand wind pressure better than foundation type constructions.

Pole buildings do have some limitations: (1) digging of the post holes in rocky soil can be difficult, (2) pole construction does not allow more than one floor, (3) side walls are generally limited to heights of 20 feet and spans of 60 feet, (4) insulated pole buildings can be as expensive as conventional stud wall construction.



Shelter protects animals from extreme temperatures



Typical livestock shelter shed

For construction plans for pole sheds, contact your county extension agent. For metal or stud-wall construction, contact a building contractor or architect.

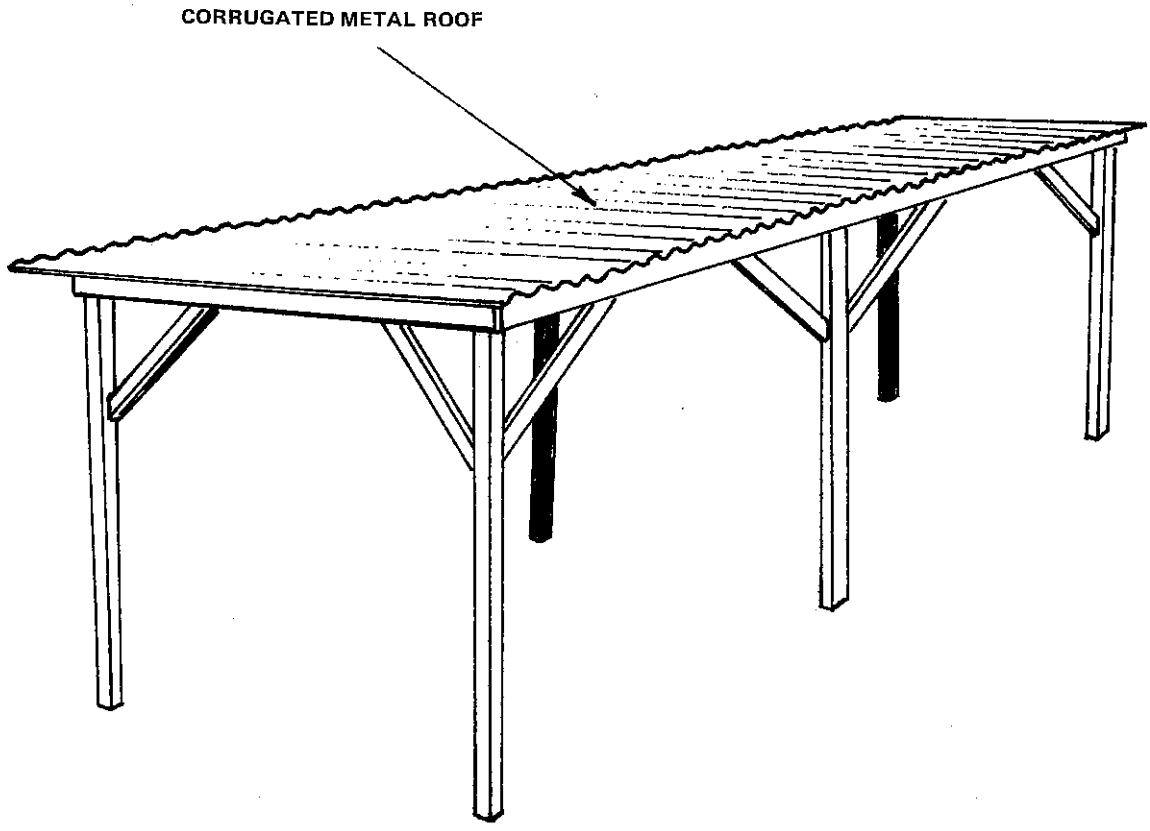
Where untreated lumber is used, support all timbers with concrete posts and build a concrete footing, extending well above ground, around the enclosed portion. Use adequate wind braces.

Shed roofing may be of any of the conventional types that resist wind damage—corrugated tin, fiberglass sheets, or plywood.

Place eave troughs to carry rain from the roof into an area that will drain the water. The ends and back of the shed should be closed, except for doors that can be opened for ventilation if the shed is used in hot weather.

Shade Shelters

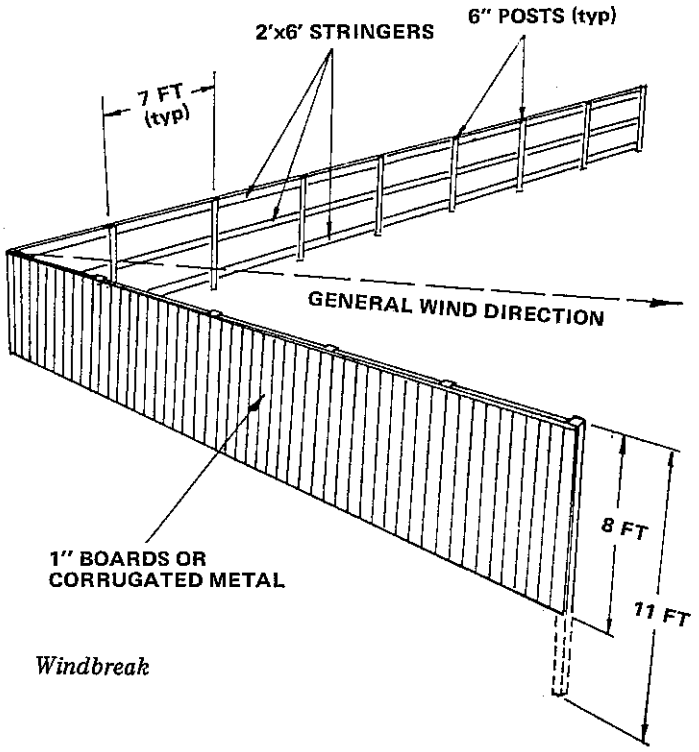
Shade is important in corrals or pastures where temperatures are 90° F or above for more than a few days of the year. Where there are no trees, artificial shade is required. Shade shelters should be 10 to 12 feet high and built on well-set poles. Provide 30 to 60 square feet of space for each mature animal. Where possible, locate shade shelters on high ground to take advantage of air circulation.



Shade shelter

Windbreaks

Windbreaks are essential for protection from strong or cold winds in pastures or in corrals where natural protection is not available. A suitable windbreak is a board wall 8 feet high. It should be built on the windward side of a lot or pasture. An angled windbreak, enclosing all or part of two sides of a corral or fence corner is preferable to one-sided protection.



Windbreak

Windbreaks can be constructed of wood, both wood and metal, or concrete. Concrete will last about twice as long as wood construction, but will have about twice the initial installation cost. Make every effort to use natural windbreaks.

The framework for a wood or wood and metal windbreak may be of 6-inch posts. Set the posts at least 3 feet in the ground and about 7 feet apart. Attach four 2 x 4-inch boards that are long enough to reach three posts, about 21 feet. Eight foot 2 x 4-inch boards can be used, but the waste in overlap will be greater than with the longer 2 x 4's.

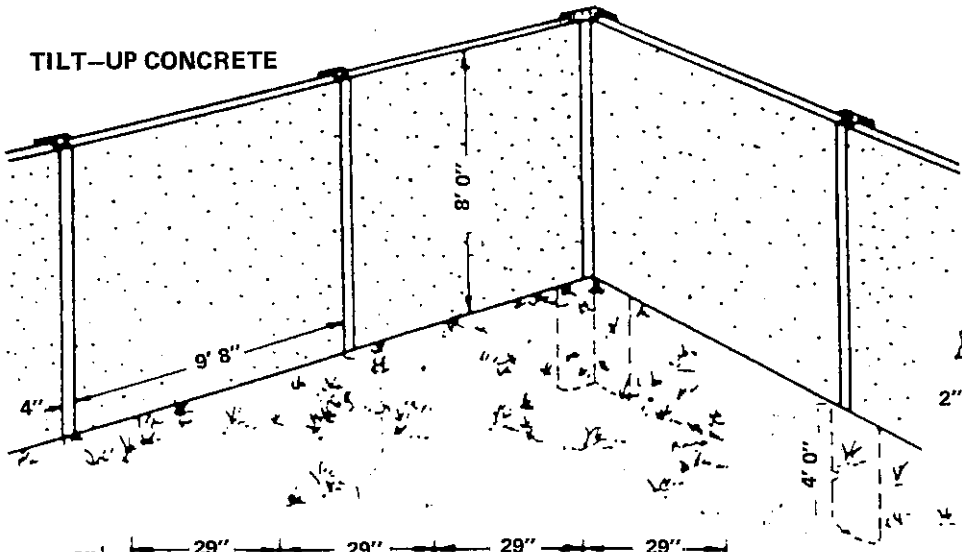
The wall may be made of 1-inch boards 8 feet long or of corrugated metal. The siding material used will depend on availability and cost.

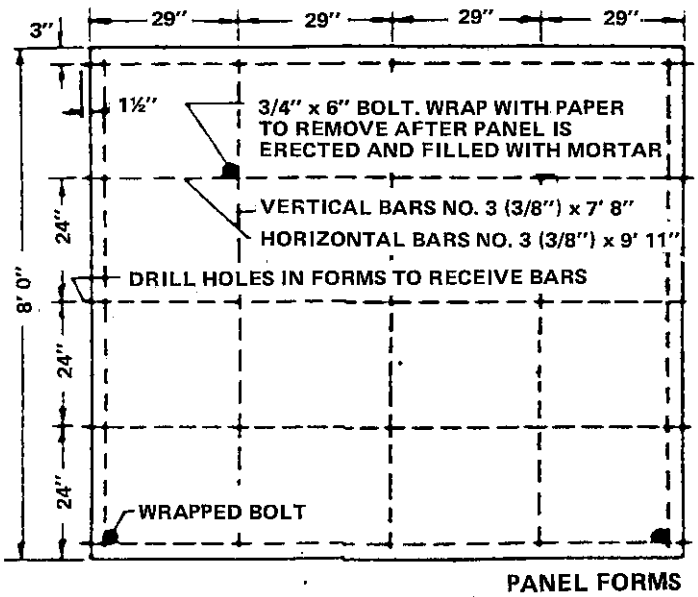
Wood windbreak

Concrete panels can be used to make a windbreak:

1. Dig post holes to the required depth and size. Set vertical rebar and pour the footings.
2. Set panel forms on plastic over a concrete floor or a sand bed. Set steel rebar and pour panels.
3. Prefabricate column forms.
4. Grease ends of horizontal panels and cover ends of panel with plastic to prevent cement from bonding to the panel.
5. Set panels in place with a 1-ton tractor with a front-end loader.
6. Install panel forms and pour concrete.

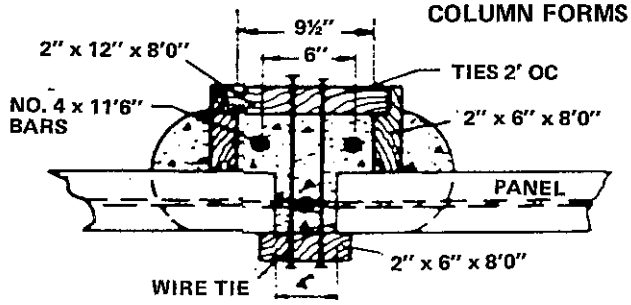
See drawings below to clarify the construction of these panels.

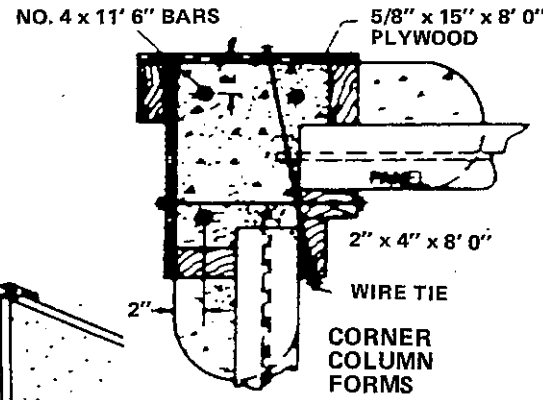


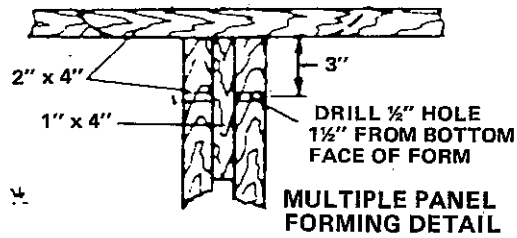


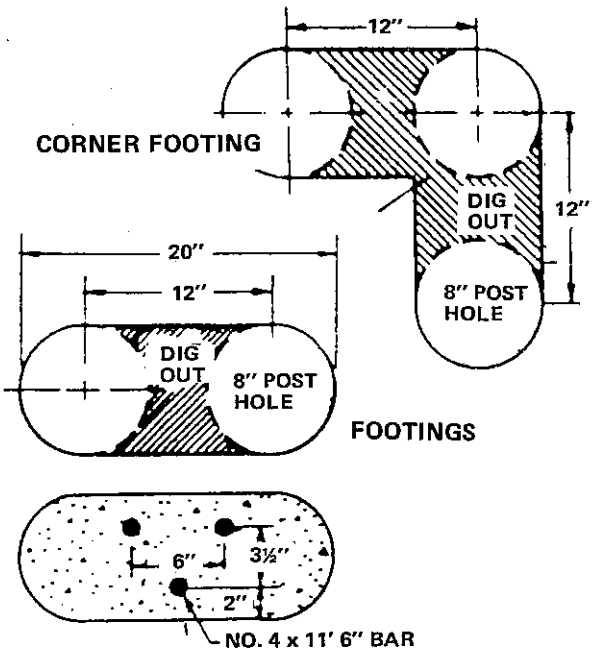
PANEL FORMS

Concrete windbreak









Feeding and Watering Facilities

Feeding and watering facilities make food and water available in corral systems and pastures. Feeding and watering is imperative if livestock are held for longer than 6 to 8 hours. Livestock should be fed twice a day and have continuous access to water. Facilities must be maintained and kept clean. Feeding and watering facilities should be placed in well-drained areas to prevent mud holes. Provide access for equipment to remove manure.

Facilities come in a variety of construction designs and materials.

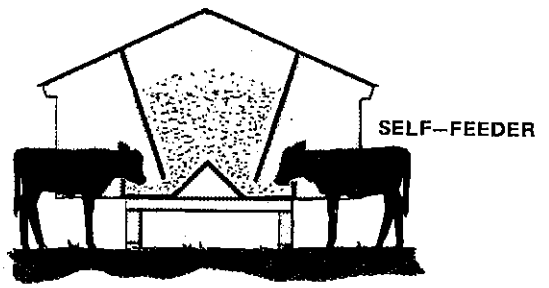
Feeding Facilities

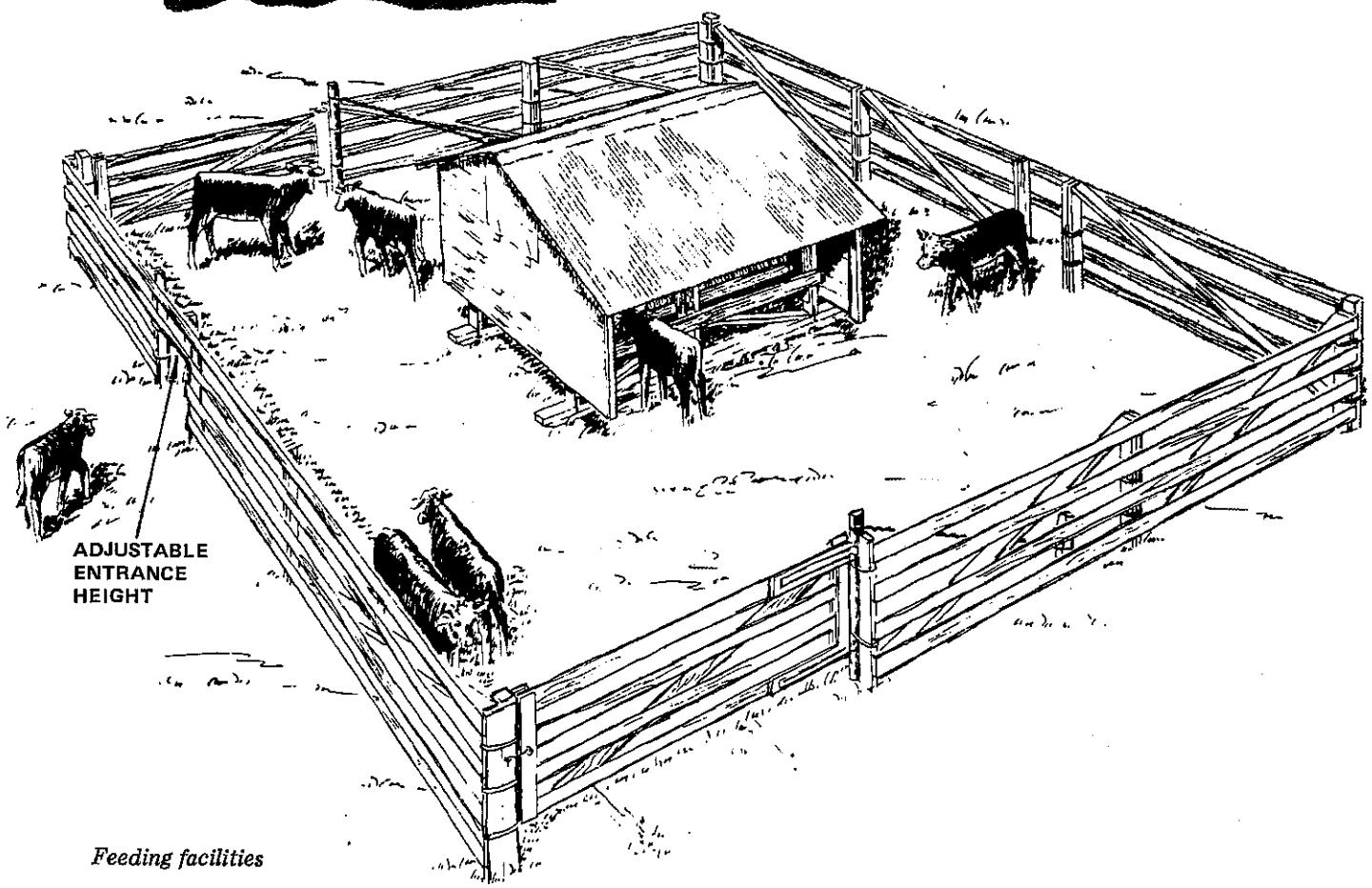
Feeding facilities keep the feed off the ground and dry. Good quality feed helps prevent illness. Self-feeders, troughs, bunks or racks are the most common kinds of facilities.

Self-feeders make feed continously available to animals. They are convenient, but do not control how much feed the animal consumes. Self-feeders can be used for all types of feed and can allow access to specific classes of livestock.

For example, calf-creep feeders allow access only to calves under a certain height. The entrance height can be adjusted to fit the height of any young animal. These work well for a diet supplement or for fattening animals.

Self-feeders can also be made too high for the younger animals to allow older animals to be fattened or given a diet supplement.



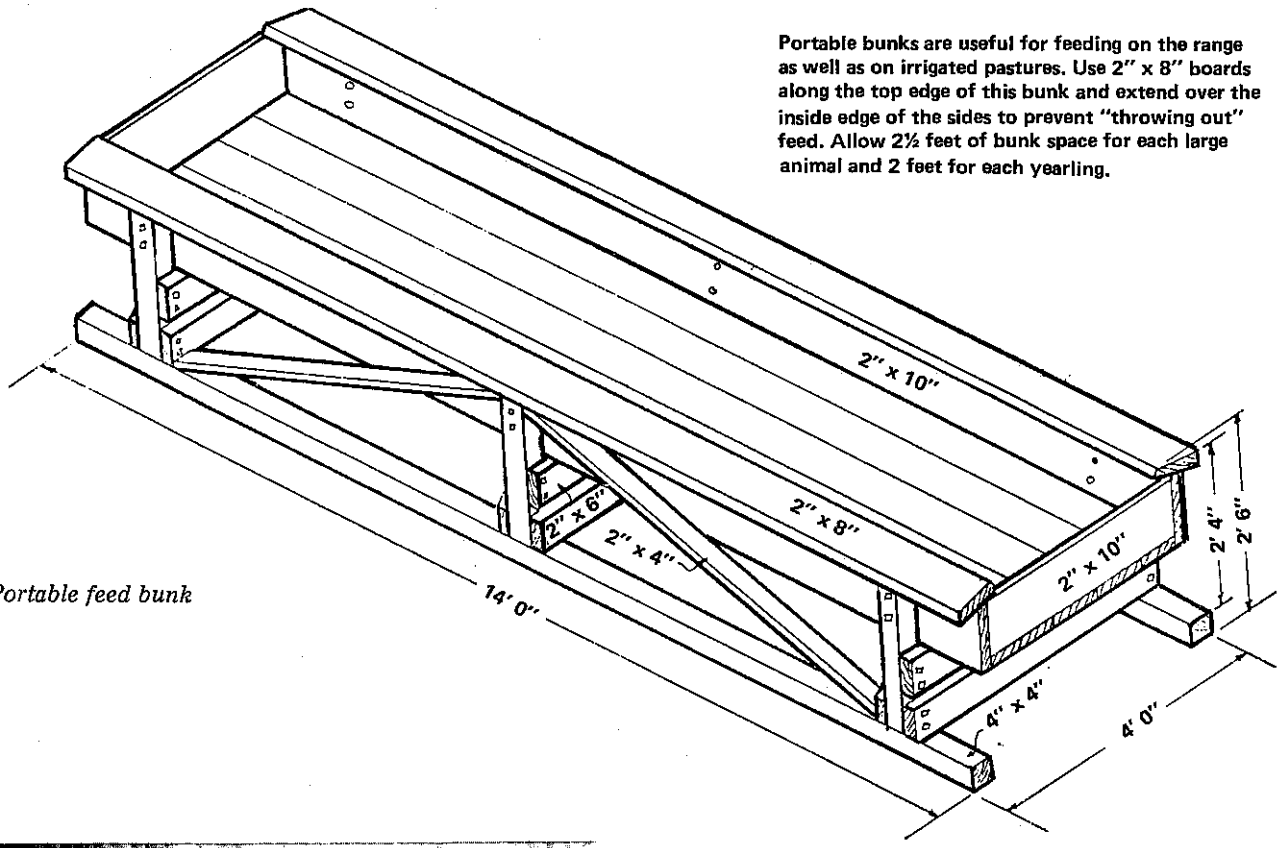


Feeding facilities

Bunks can be used to feed pellets, grain, or hay. Bunks are not a continuous feeding system; they must be filled twice a day or during normal feeding time.

A feed bunk should be well braced and wide enough to prevent feed waste. Build bunks from the most durable lumber that is readily available. If treated lumber is used, be sure the lumber is not treated with a chemical that is poisonous to the livestock. Consult your County Extension Agent.

Skids or other timber near the ground should be pressure-treated. Use well-cured lumber for the bunk flooring to prevent decay and prolong the life of the bunk. Where well-cured lumber is not available, line the bunk with tempered hardboard to minimize waste through cracks and to prolong the life of the bunk.



Portable bunks are useful for feeding on the range as well as on irrigated pastures. Use 2" x 8" boards along the top edge of this bunk and extend over the inside edge of the sides to prevent "throwing out" feed. Allow 2½ feet of bunk space for each large animal and 2 feet for each yearling.

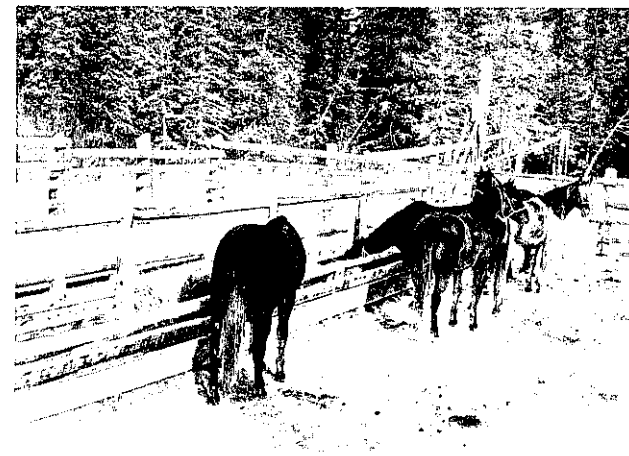
Portable feed bunk

Permanent feed bunk
Photo courtesy Montana Historical Society, Helena, MT

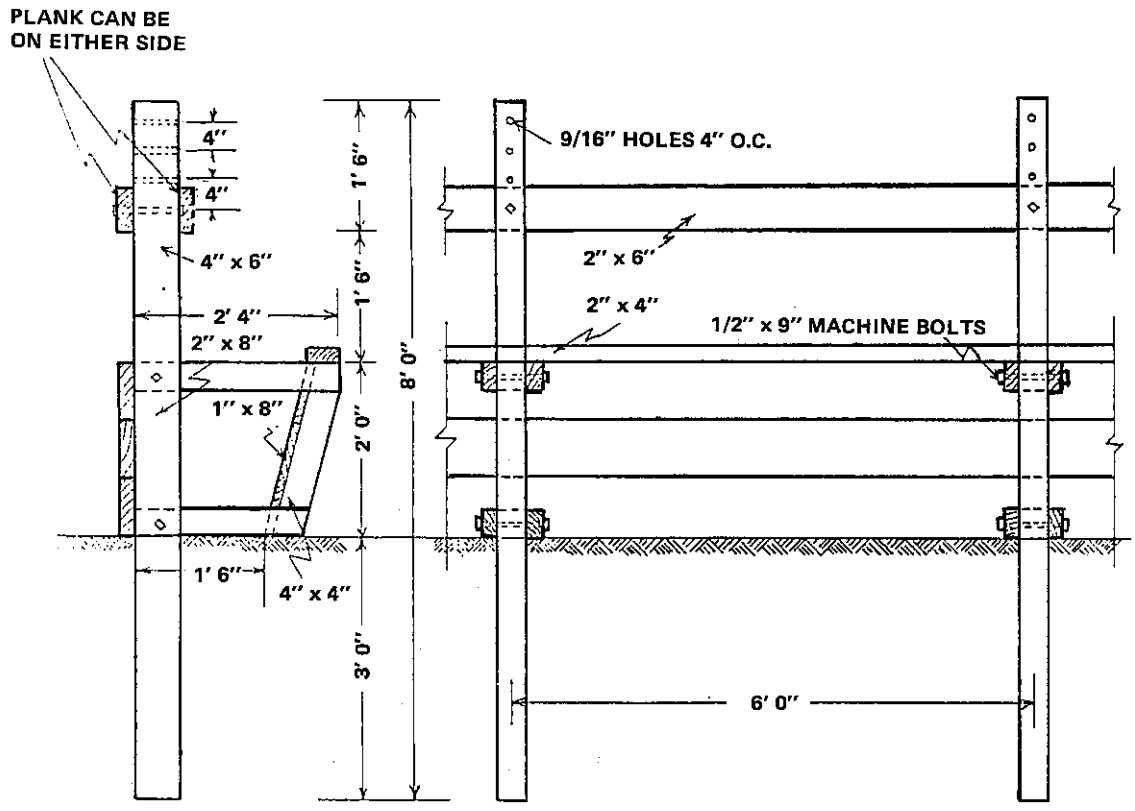
For large herds, fence-line bunks that can be filled from a wagon or truck save labor. Provide 10 to 12 feet on the side of the bunk for access by the wagon or trailer.

Individual bunks or racks can be mounted on skids and placed in the handling facility or in a pasture. The skids make bunks or racks portable. Anchor the bunk securely to prevent animals from moving the bunk when they rub against it.

Place feeders in well-drained areas to prevent mud holes. Also, make them accessible for equipment removing manure.



Stationary feed bunk

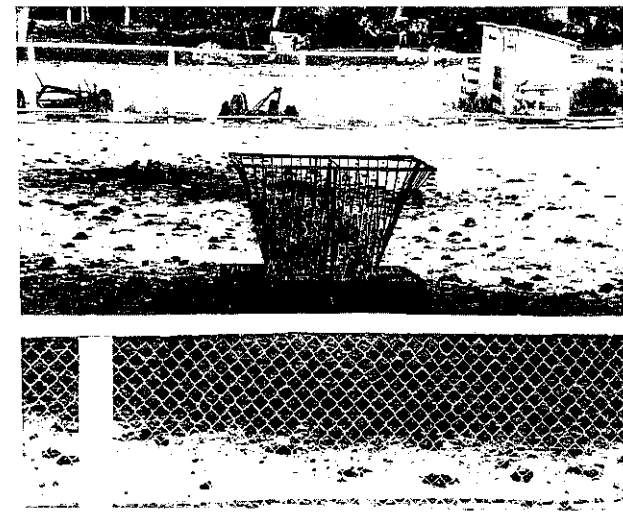


Stationary feed bunk

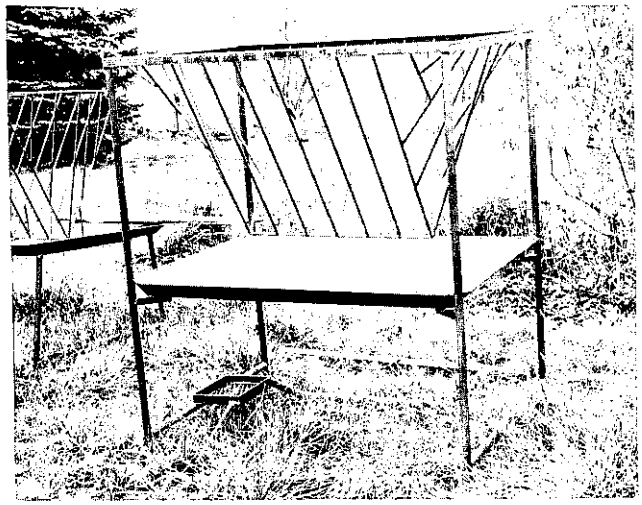
Racks are a convenient method of feeding loose or baled hay. The hay is put into the rack for continuous feeding. Provide 10 to 12 feet for trucks or wagons to fill the rack. The racks should be located on a well-drained area to reduce mud accumulation.

Racks can be built to function as both a rack and a bunk. Simply build a bunk underneath the rack with access for the animal.

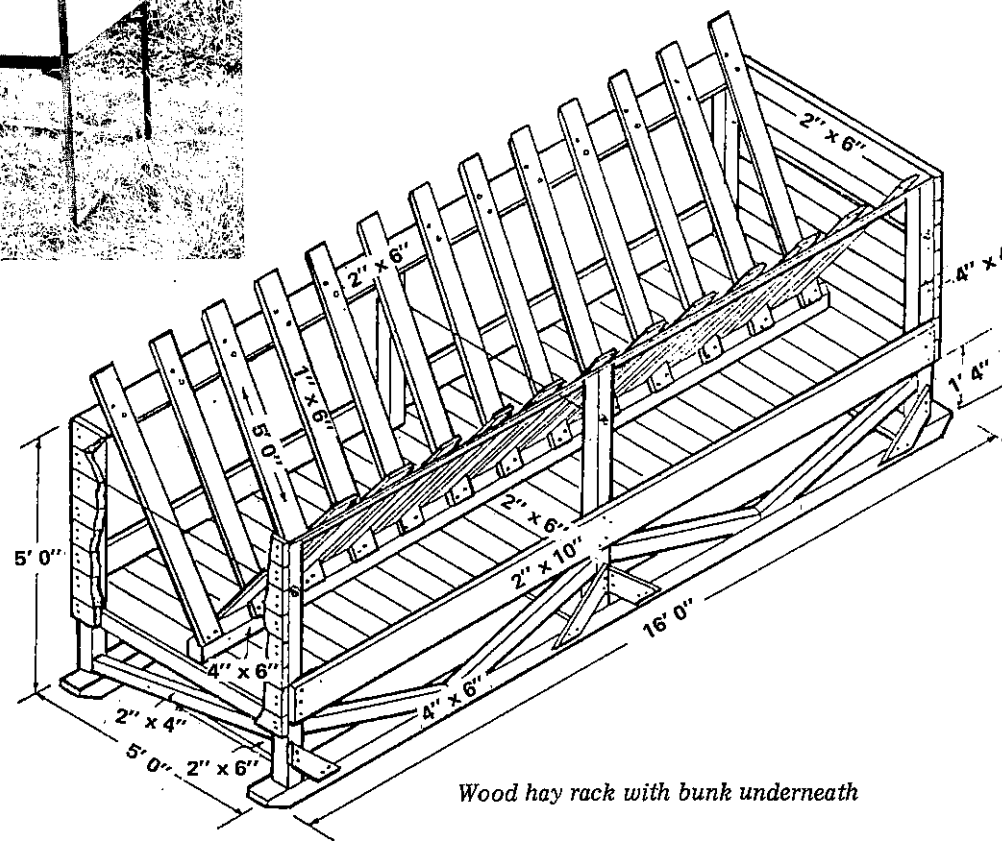
Racks can be made of wood or metal or can be purchased commercially. Commercial racks are metal and function quite well. They are portable and relatively lightweight. They are more expensive than home-made wooden racks. Their extra life and portability may make them worth the extra cost. The longer the equipment is to last and the heavier the animals using the facility, the heavier the equipment must be.



Metal hay rack with bunk underneath



Commercial metal hay rack



Wood hay rack with bunk underneath

Watering Tanks and Troughs

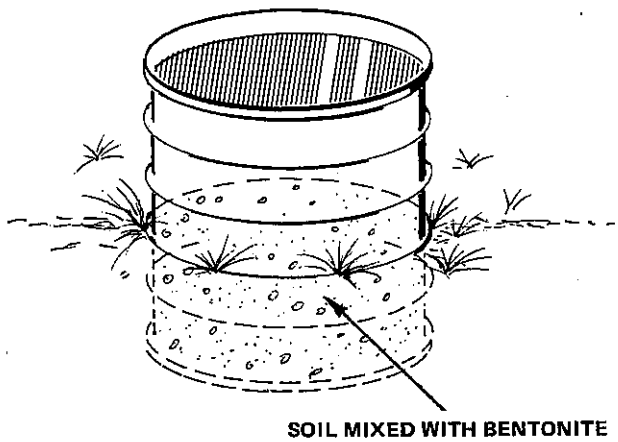
Cattle and horses will drink about 12 to 15 gallons of water per day, depending on the temperature and feed. Sheep will drink about 1½ gallons of water per day.

Most corral watering troughs are concrete or galvanized steel tanks. They can also be made of wood, old tractor tires, or fiberglass. Steel usually is cheaper, but is not as durable as concrete. One tank placed in a fence line or fence corner may serve two or more pens or pastures.

Where large quantities of water are to be stored, round tanks are most practical. Less material is needed to build them than square or rectangular tanks.

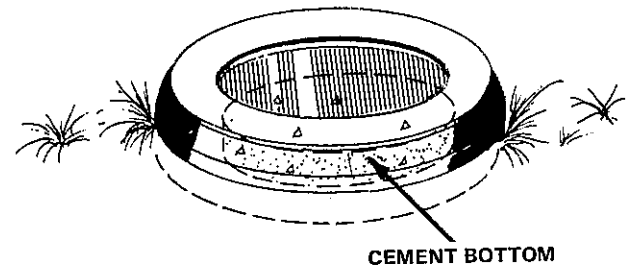
A small round tank may be made with a section of concrete culvert pipe. Cut the pipe to a length of 22 to 28 inches. Heights are adjusted for small animals such as young sheep or for mature cows or horses. The bottom can be made by either pouring a concrete bottom or by setting the culvert in the ground and adding bentonite to the dirt in the bottom. If concrete is used, set the concrete on a piece of plastic and pour a 4-inch bottom inside the culvert. Allow the concrete to set up. Then set the culvert in a hole the same depth as the concrete. Backfill around the culvert so the top of the concrete is at ground level.

If bentonite is used, dig a hole to about 6 inches. Cover the bottom of the hole with bentonite. Take the removed dirt and mix with bentonite and put back inside the culvert and back around the culvert The bentonite will seal the dirt and allow the tank to be moved easily and resealed. Bentonite can also seal leaky tanks.



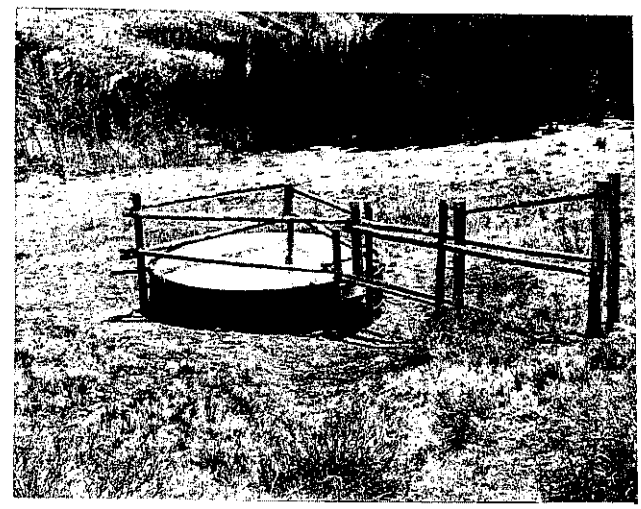
Steel culvert water tank

An old tire can make a stock water tank. Place the tire in the desired location. Fill the bottom with concrete and allow it to set up. The concrete seals the bottom of the tank and makes an inexpensive water tank.



Old tire tank

Wooden tanks can be made of cedar or redwood. These tanks come in precut kits ready to assemble. The side and bottom boards are tongue-and-grooved to make a good fit. When the wood becomes wet, it swells and seals. These tanks are very portable before assembly. They do not last as long as other types of tanks and need to be maintained more frequently.



Redwood stock tank

All tanks should be constructed for easy draining and cleaning. Moss and algae build up over the summer and dirt and debris accumulate. Clean tanks at least annually.

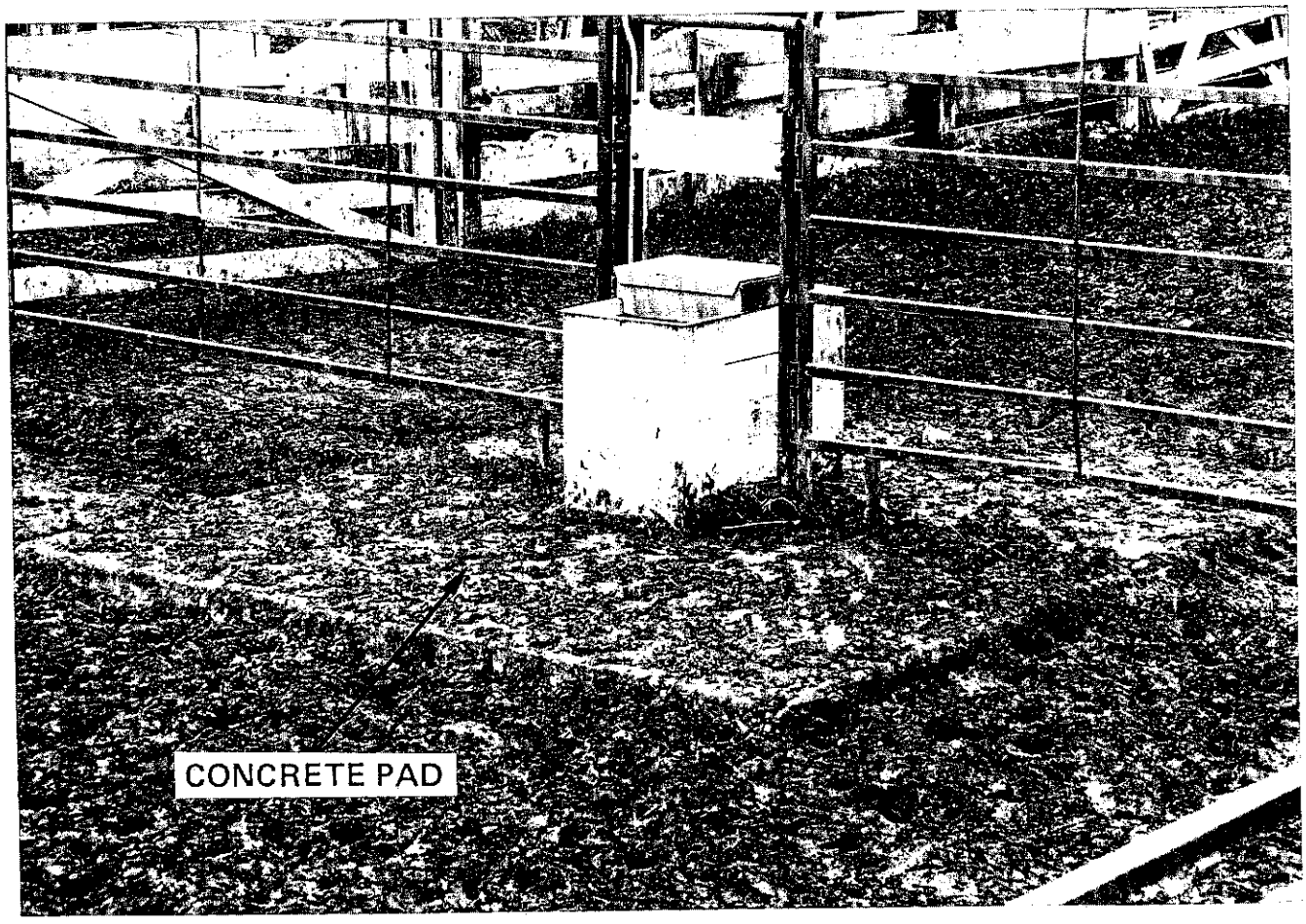
In cold climates, place the tanks in a protected location. Placing tanks behind a windbreak or in a shed will reduce the amount of energy required to keep the water from freezing. A heating device should be placed in the tank during freezing weather. Cattle will not drink ice cold water.

In humid climates, place tanks on a concrete platform to prevent a mudhole. A concrete slab can be poured or cinder blocks can be laid down and filled with dirt to make the pad. Pin the outside blocks with rebar and a few of the inside blocks as well. Bend a hook in one end of the rebar. Drive the reinforced bar into the ground in one of the holes in the cinder block. Hook one edge of the block with the hook in the reinforced bar to hold it in place.

If the tank has pressurized or gravity feed, the amount of water in the tank is controlled by a float valve connected to a pipe from the supply source. Where the water is supplied irregularly (such as from a windmill) there should be a continuous supply. If an automatic or float-controlled intake is used, guard the mechanism against damage by livestock. The tank should be placed on ground that slopes away from the storage tank for a distance of about 20 feet.

Cinder block pads help prevent mud holes

If at all possible, all tanks should be put on a concrete pad or on cinder blocks to prevent the tank from "pedestaling."



Water tank on concrete pad

Photo courtesy University of Montana Mansfield Library, Missoula, MT

Trailing Livestock

Ranchers are often forced to move livestock between widely scattered ranges. The two most common ways to move livestock are trailing or trucking. Railroads are sometimes used if the distance is great and connections are convenient. It is almost always better to haul animals. Trailing livestock depletes roadside vegetation, damages roads, and disrupts traffic. If trailing is necessary, avoid public roads. Use roads not open to the public, or old driftways. Consult appropriate land management agencies before existing driftways are rerouted or new ones are established. Proper right-of-way easements are needed from the supervising office of the appropriate agency. An engineer should be consulted for expert advice on construction techniques.

This handbook discusses facilities necessary for trailing livestock. It does not discuss transporting them.

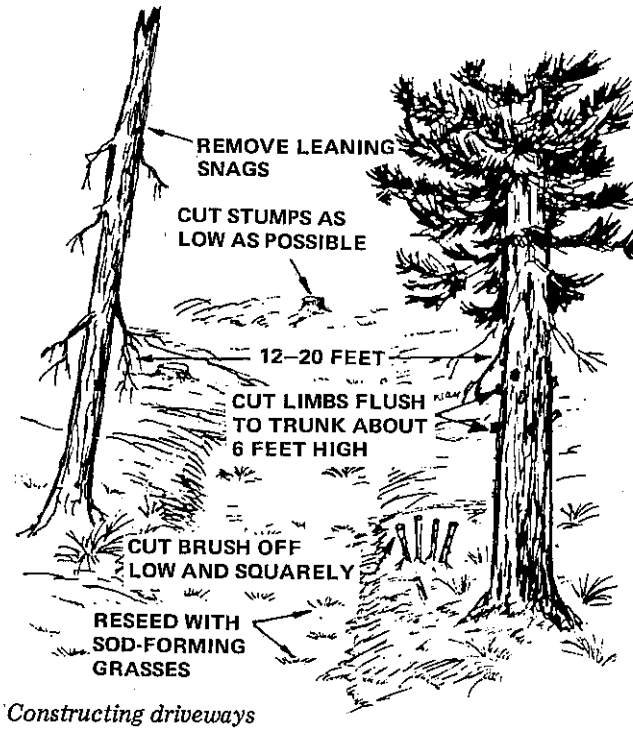
Driveways and Driftways

Driveways and driftways are used to move livestock to new pastures, handling facilities, or to new feed or water. Driveways and driftways are expanded trails that accommodate a large number of livestock. By making an unobstructed trail, livestock can either move on their own or be driven to these areas without hauling.

Driveways

Driveways are expanded trails used to move livestock to new pastures or handling facilities. Livestock are not allowed to drift on their own but instead are driven by riders or hazers. In dense understory, the driveway must be cleared; in open areas the animals are allowed to spread out and are herded. Hauling livestock is less taxing on the livestock and on the environment.

If you determine that a new driveway is needed, the location should be carefully planned. Avoid ridge tops, wet areas, large cut banks, or steep slopes. Locate the driveway where it will have the least impact on the vegetation and do the least damage asthetically. Construct driveways out of sight of roads and trails. When clearing through dense vegetation, a clear, straight path is most efficient, but a driveway of varying widths and wavy lines will blend into the natural topography. Avoid sharp turns or steep grades that restrict movement and allow livestock to bunch up. Bunching increases damage to the vegetation and increases erosion.



Constructing driveways

Consider food and water requirements when planning driveways. Providing access to water is often more important than access to forage. Feeding and watering should not be on fragile riparian areas that can be damaged by large concentrations of livestock.

If possible, leave small brush and the large trees to hold precipitation and improve aesthetics. Sod-forming grasses should be seeded in the driveway to reduce the impact of the livestock. Maintain mat-forming forbs. The amount of brush disposal will be dictated by fire protection standards. Brush removed from the right-of-way can ordinarily be scattered, but fire prevention standards may require that it be piled and burned. Burning must be conducted under the prescription written by the fire management officer.

Avoid locating the driveway where large trees will need to be cut. If they do not obstruct movement of the livestock, leave them. Clearing widths from 12 to 20 feet is normally adequate in dense timber. In open areas restrict driveway width to 200 feet. Cut tree limbs flush with the trunk to at least 6 feet high. Remove snags in the right-of-way. Remove downed logs or other obstacles that will impede the movement of livestock. Cut stumps as low as possible. Cut brush low and square the ends to reduce injury to the animals. If the brush does not impede movement or obstruct vision, leave it.

The center line of the driveway should be signed with standard metal stock driveway signs if the trail is through open country. This discourages using the driveway for animals other than those being trailed. Directional signs should be placed at intersections. It is not necessary to sign the center line of a trail when the route has been cleared of vegetation and the driveway is obvious.

22-5 7" x 10"
Black on yellow
FSN 9905-00-887-8118

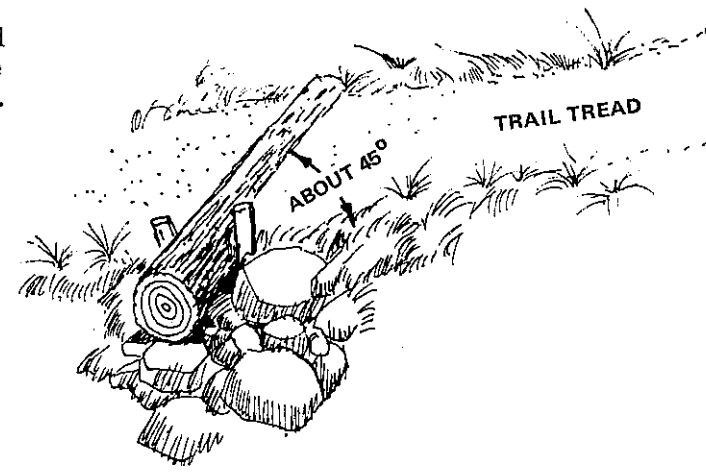
22-6 7" x 10"
Black on yellow
FSN 9905-00-887-8119

Small metal stock driveway signs (signs are available from USDA, Forest Service)

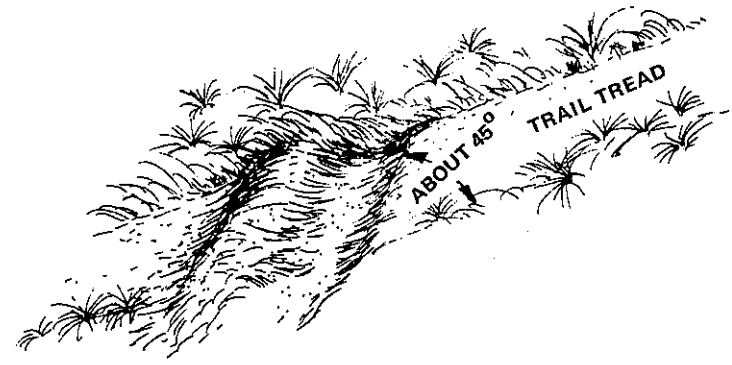
Construct the driveway to accommodate occasional vehicular traffic for hauling salt, fencing materials, and horses, and to provide access for fire suppression.

Water bars, open tops, or kelly humps should be put in the trail to divert water from the surface.

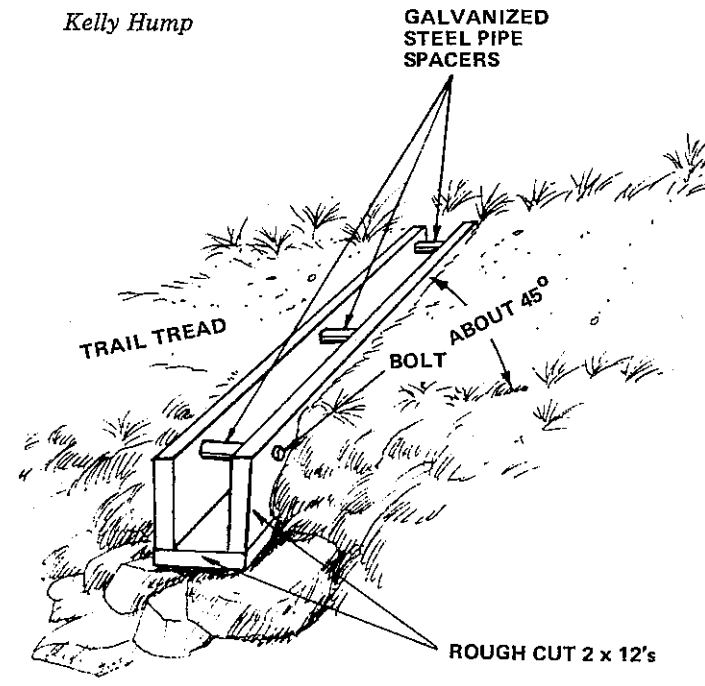
Consult an engineer for guidance in constructing driveways.



Water bar



Kelly Hump



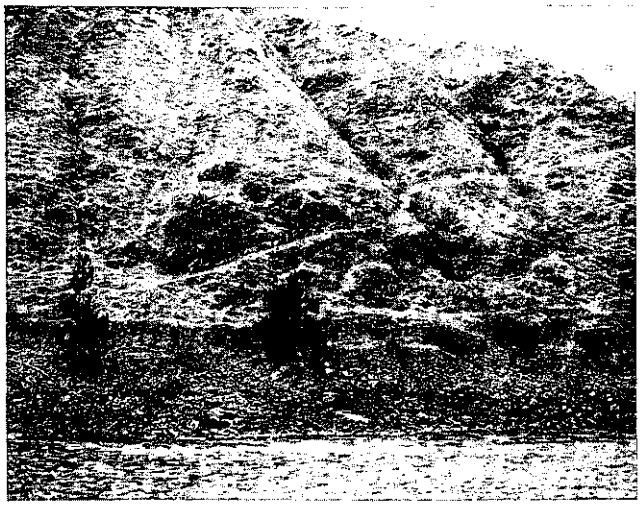
Open top culvert

Driftways

Driftways are planned trails that allow animals to move to otherwise unavailable forage and water. They are similar to driveways except that fewer animals will use them at one time, and these trails allow animals to drift unherded. Driftways are constructed exactly as driveways but are no wider that 10 to 12 feet.

Since the reason for constructing a driftway is usually because animals must pass through difficult terrain, extreme care should be taken to protect the driftway from erosion. Water bars, open tops, or kelly humps should be placed to divert water from the trail surface. Maintain a ground cover of sod-forming grasses or mat-forming forbs.

Do not construct driftways in areas of high use or where they will have visual impact. Avoid sharp turns and steep grades. If possible, construct the driftway to accommodate occasional vehicle use for hauling salt, fencing materials, or fire suppression.



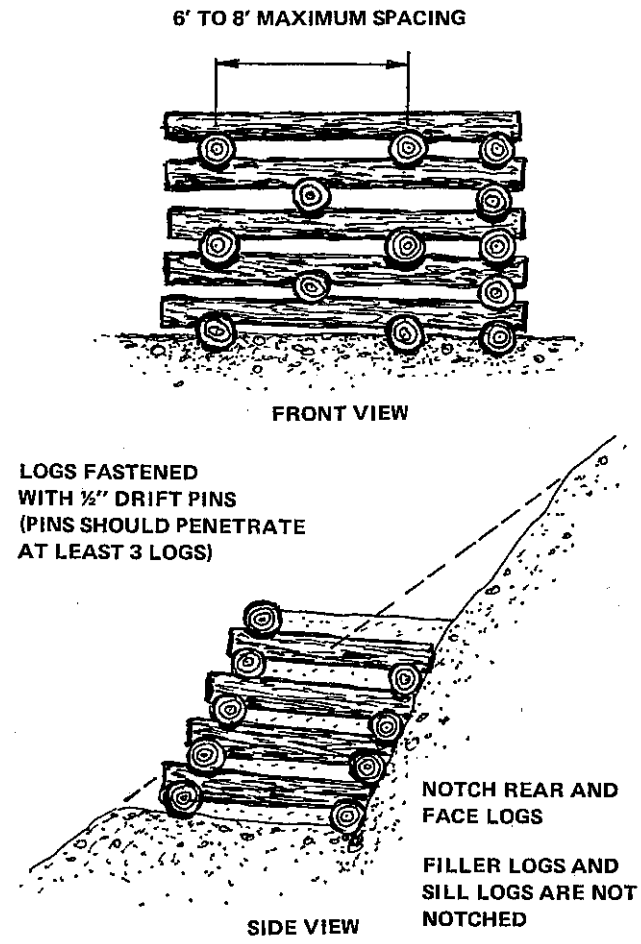
Livestock distribution trails to water

Crossings

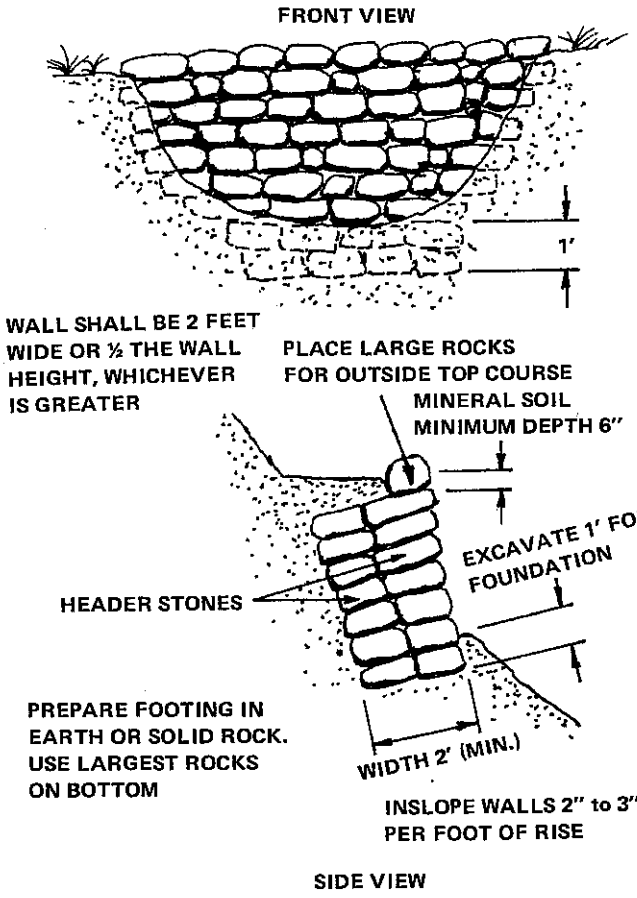
Determine how best to cross streams or wet areas. Low-water crossings or corduroy decking are often best. A bridge is probably not necessary for cattle or horses unless water is deep or swift.

Low-Water Crossings

Site selection of low-water crossings is very important. A site along the stream with stable, gently sloping banks, slow shallow flows, and a stable bottom is the most desirable crossing. Alterations to a stream bank will intensify the stream development processes. For example, if the stream is in a state of deposition, the stream will continue to deposit material, but at an increased rate. Or, if the stream is eroding, it will continue to erode after the crossing has been constructed. These processes may only occur during high water and will not affect the normal operation of the crossing. Correcting the problem may be as simple as removing a few shovels of deposited illuvium each spring, or it may require retaining walls. If retaining walls are needed, proper design and construction criteria will need to be determined by engineers. The cost of these structures will depend on their size and on the type of construction used.



Log retaining wall

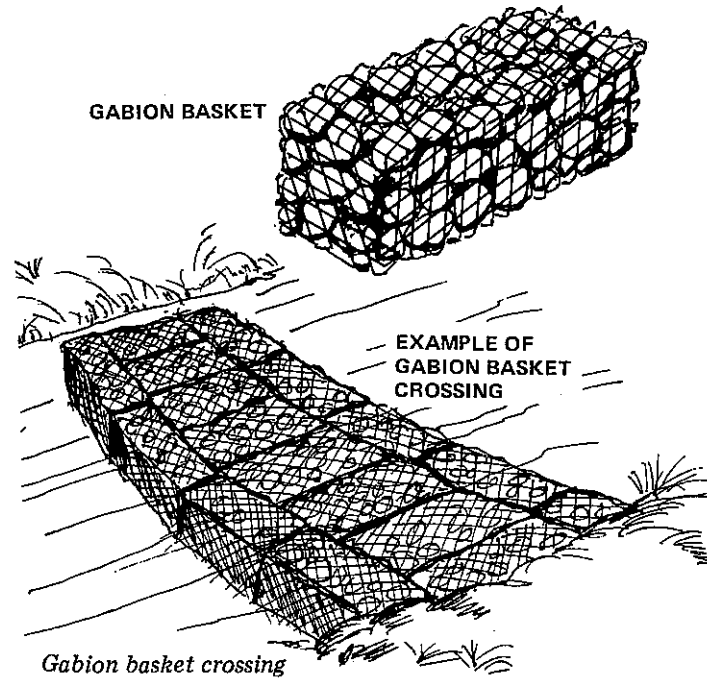


Stone retaining wall

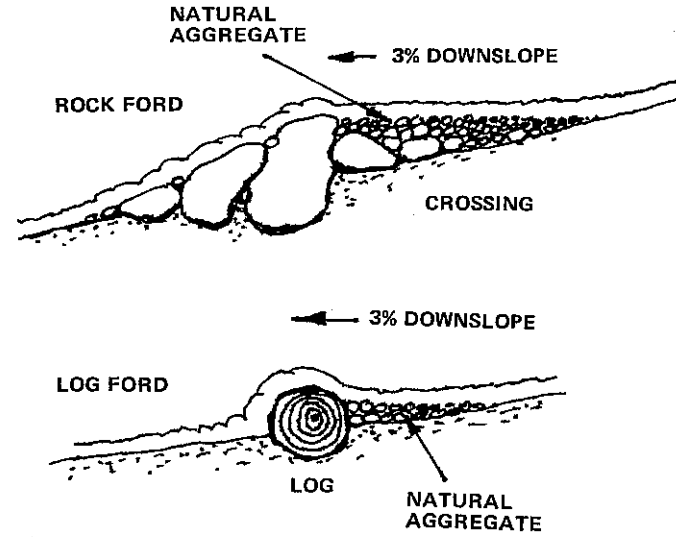
There are several design possibilities for problem crossings. *Precast concrete* pads can be laid in the bottom or concrete pads can be poured in-place during low water. These pads need to be reinforced with gabions on the up-and down-stream sides. Gabions are permanent wire baskets filled with rock that allow water to move through them.

Natural aggregate can only be used in areas with already stable bottoms where the aggregate will not be pushed down into the bottom material. Build a dam out of large rocks or by pinning a log on the down-stream side of the crossing to retain the aggregate. Rocks should be a least 1-cubic foot. Then, back fill the dam to the top with natural aggregate. This makes the crossing fairly level. The tread surface should have a 3-percent down slope towards the retaining dam. To be effective, the flow at high water should not wash aggregate away.

Laying rock filled *gabion baskets* side by side in the stream bottom can also provide a stable crossing. The baskets need to be placed so they do not stick up above the stream bottom and obstruct the stream flow to cause excessive erosion and deposition. The gabions need to be filled on the top side as full as possible. The aggregate material should be as small as possible to prevent the animals feet from being caught in the holes and voids of the basket. The gabions should be wired together to prevent any portion of the structure from shifting and leaving gaps in the crossing surface. Vehicles crossing can easily destroy the wire mesh and tear it loose.



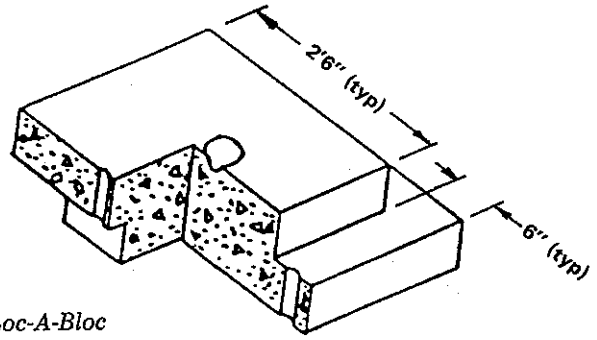
Gabion basket crossing



Natural aggregate crossings

Concrete blocks can be locked together with reinforcement bar. These blocks are called Lock Blocks and are approximately 2½ x 2½ feet. The blocks can not be purchased. Construction may have to be contracted to a concrete supply company. This crossing is most effective in excessively boggy areas. These blocks work well when placed on geotextile, a mat-like cloth designed to spread loads placed on the material. The geotextile prevents the lock blocks from being pushed down into the soggy bottom material.

The geotextile material is first rolled out over the area to be crossed. The lock blocks are then placed on the geotextile material to form a solid, smooth crossing surface. The crossing surface should extend past the edge of the wet area onto stable ground. The crossing must be anchored to prevent shifting.

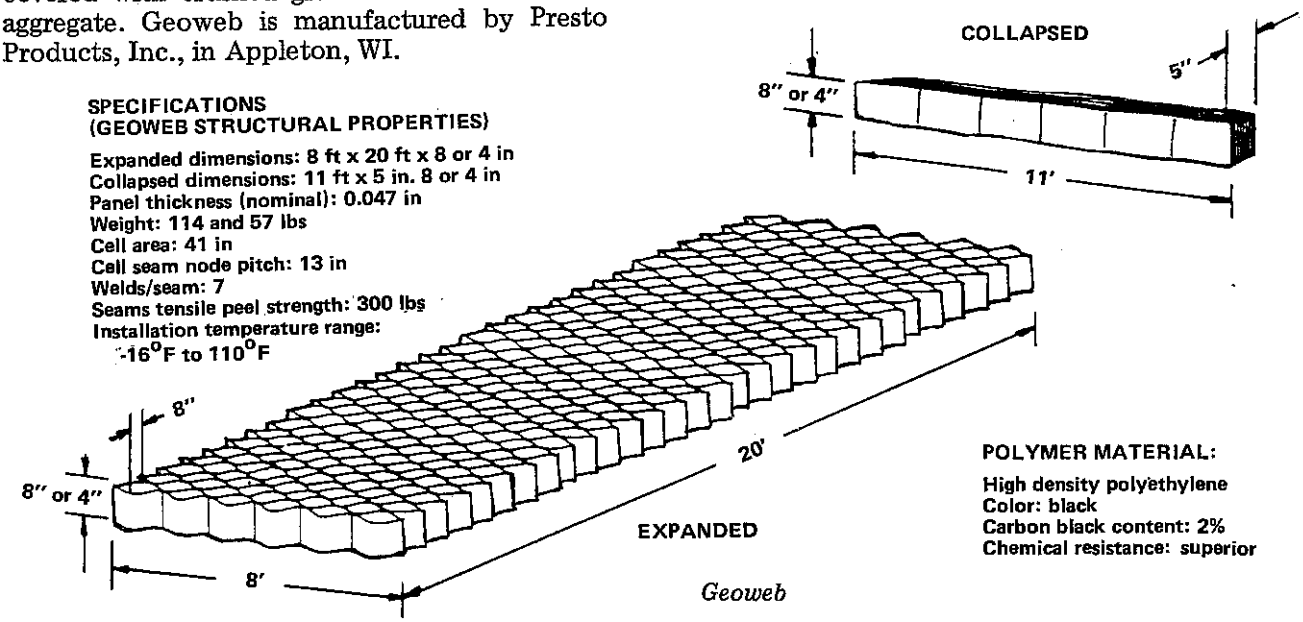


Loc-A-Bloc

A new material called "Geoweb" can be used with geotextile. Geoweb is a collapsible high-density polyethylene plastic that expands into a honeycomb grid. It is lightweight and durable. Geoweb is placed on top of the geotextile and then covered with crushed gravel or natural stream aggregate. Geoweb is manufactured by Presto Products, Inc., in Appleton, WI.

SPECIFICATIONS
(GEOWEB STRUCTURAL PROPERTIES)

Expanded dimensions: 8 ft x 20 ft x 8 or 4 in
Collapsed dimensions: 11 ft x 5 in. 8 or 4 in
Panel thickness (nominal): 0.047 in
Weight: 114 and 57 lbs
Cell area: 41 in
Cell seam node pitch: 13 in
Welds/seam: 7
Seams tensile peel strength: 300 lbs
Installation temperature range:
-16°F to 110°F



POLYMER MATERIAL:

High density polyethylene
Color: black
Carbon black content: 2%
Chemical resistance: superior

Geoweb

Geotextile crossings can bridge boggy areas or flowing water up to 7 feet deep. Site preparation may include excavation. Geotextile is rolled out over the crossing area well beyond the boggy area or the bank to prevent failure. If geoweb is used, it may have to be pinned to prevent it from collapsing into rolls until the aggregate is in place. Once the aggregate is installed, the pins can be removed.

Geotextile crossings are much less expensive than concrete crossings. Much of this savings is in labor costs, the rest in material costs. Geotextiles can be easily transported to remote areas. Three people can install a crossing. Materials are small and light enough to be hauled in a small pickup. Crossings can be constructed in 1½ hours once excavation is complete. It can then be immediately crossed. Consult an engineer if excavation is necessary.

Geotextile fabric comes in a variety of weights and two basic construction designs—cloth and grid. The cloth comes in a woven and an unwoven design. Consult engineers and the distributors of the product in your area for recommendations on the type and weight of the material to be used.

With all design methods, it is important that the bed of the surface material of the newly constructed crossing be layed even with the bottom surface of the channel to prevent excessive deposition or erosion. The new bed surface must be extended far enough up the bank that water is not forced around the ends. Water must flow over the crossing for the best results.

Culverts

Culverts may be used in small streams where the run-off level is not large. Culverts are better than bridges or low water crossings because disturbance to the stream is kept to a minimum and culverts are less expensive to construct than bridges or low-water crossings. Culverts can be made of metal, concrete, polyethylene, stone, or even wood.

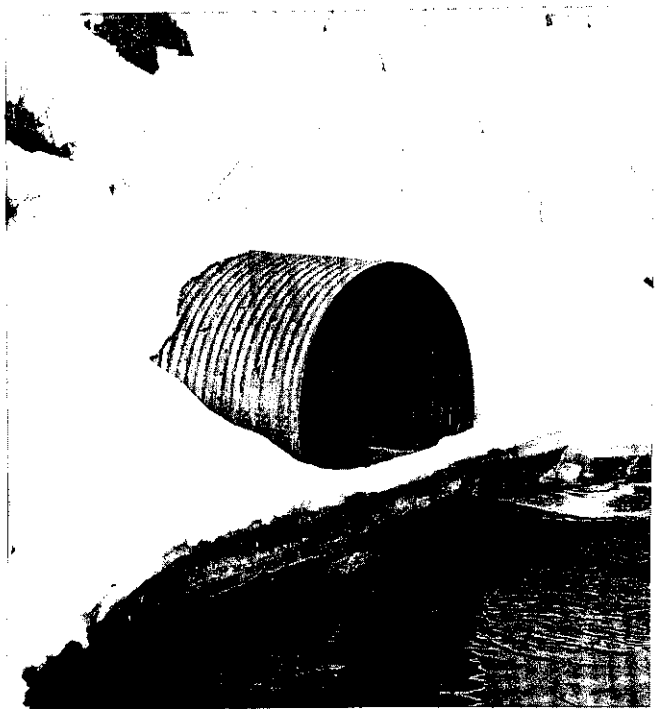
Excavation for the culvert should be 24 inches wider than the diameter of the culvert. If soft or unstable native material is contacted, the excavation site may have to be even wider to provide a stable bed for the culvert. Adequate compaction of backfill material is crucial to prevent corrugated metal structures from flexing or elongating horizontally from traffic crossing the culvert. Deflection can build up to the point that the culvert will fail. By properly tamping the backfill material, the culvert gets the proper support.

If fill material is loose, it washes away from the culvert. A general rule of thumb for the amount of top fill, is half of the diameter of the culvert. Greater than half is a good idea if the culvert is small. A minimum of 12 inches of fill is required for all culverts except concrete. With concrete culverts it is not as imperative to provide a compacted fill over the culvert.

For greatest efficiency, the culvert should be aligned to allow water a straight entrance and exit. The grade line of the culvert should be slightly greater than the grade of the natural stream to prevent sediment buildup inside the culvert.

Metal culverts are most common. They are durable, have a fairly long service life, and are relatively light to transport. The protective coating can be damaged by dropping rolling, or bending the culvert. Damage to the coating will allow the culvert to rust or corrode. Fill material larger than 3 inches in diameter should not be used within 6 inches of the culvert. These rocks can wear the protective coating off the culvert.

Concrete culverts are good in acidic or normal conditions, but degrade under alkaline conditions. Concrete culverts are strong and will last for a long time. Concrete culverts are heavy and difficult to transport to the site. Installing concrete culverts can cost 2½ times that of other culverts.



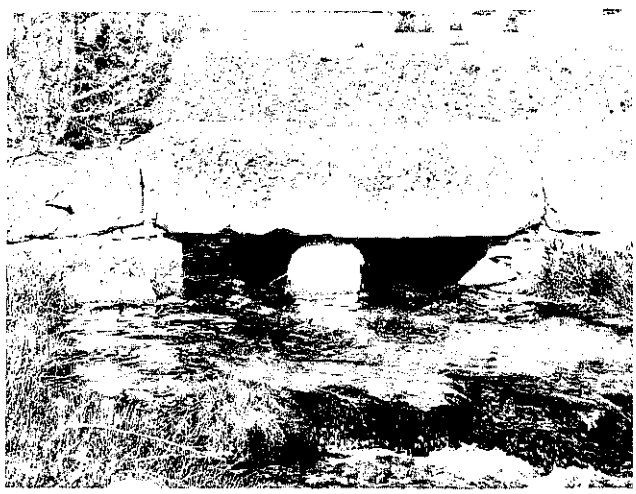
Metal culvert

Concrete culvert

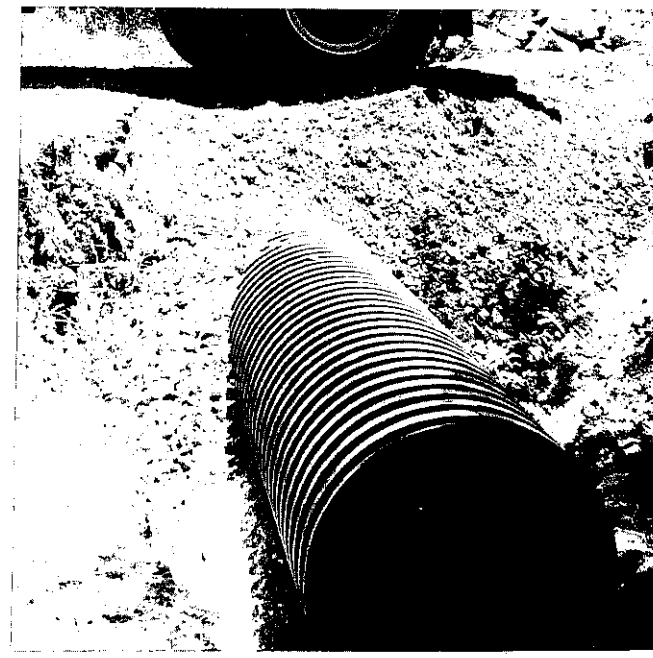
Polyethylene culverts were initially designed for use in toxic waste conditions because of their resistance to corrosion. They are light, strong, durable, and inexpensive. Polyethylene culverts can be carried by a single person. They are flexible and can conform to minor changes in the bed or bank without failure. Polyethylene can be cut with any handsaw.

Stone culverts have the least expensive material costs but are very limited in their application. They are constructed of on-site materials. A supply of large flat rocks is required. The stream to be crossed can not be very wide or have a very large flow or the culvert will fail. Stone culverts are more aesthetically pleasing than metal or polyethylene culverts.

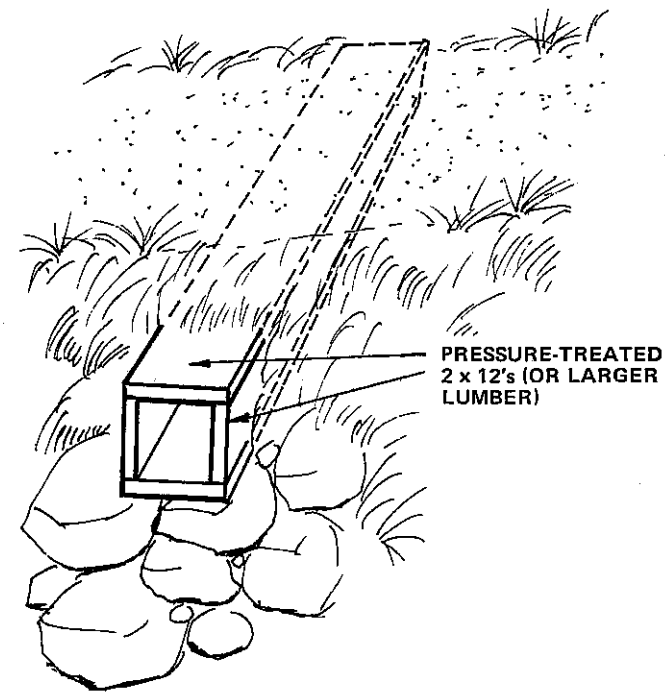
Wood culverts are easy to construct and are also asthetically pleasing. These culverts can easily be precut and hauled to the site. The size of the culvert needed is a limiting factor. Lumber over 12 inches wide can be purchased, but most lumber yards do not stock it. Lumber can be pressure-treated or it can be treated before the culvert is installed. The preservative will extend the life of the culvert and reduce replacement costs. The wood culvert is made from pressure-treated 2 x 12's. Prices may vary if the preservative is applied after the lumber is purchased.



Stone culvert



Polyethylene culvert

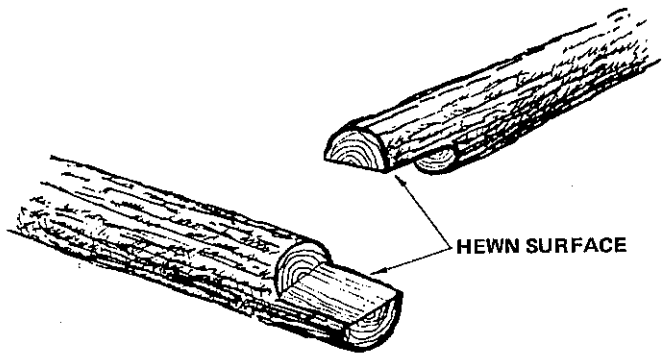


Wood culvert

Corduroy

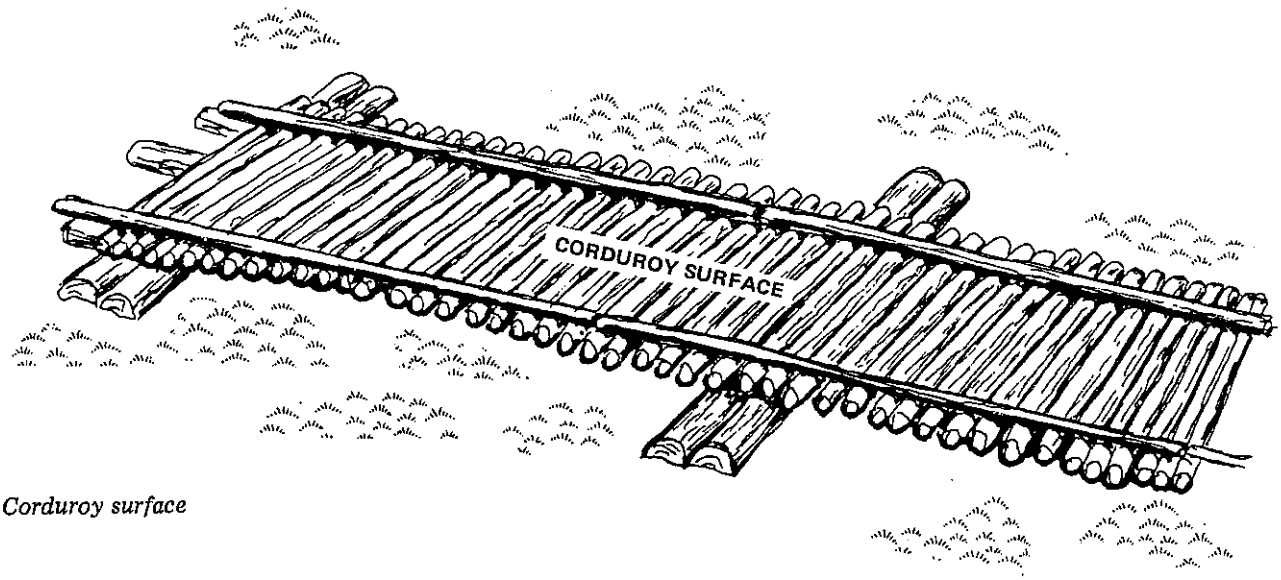
Log crossings called "corduroy" may be best for crossing wet or boggy areas. Corduroy can achieve the desired results within environmental constraints.

Corduroy is constructed by cutting stringers from on-site timber. These stringers should be approximately 12 feet long. They will rest on mud sills cut of the same material. The mud sill should extend past the width of the corduroy tread. The decking is then attached to the stringers. The decking can be made of sawed material, split poles, or round material. Any round material should have a flat tread surface hewn on it to provide a more stable walking surface.



Hewn log surface

Decking runs perpendicular to the direction of travel to prevent slippage when wet or frosty. Any surface where materials meet should be hewn to make a flat surface on both pieces where they contact each other. This can be done with a chainsaw, hammer and chisel, or an ax. Decking should be nailed with 3/8-inch steel spikes on each end.



Corduroy surface

Bridges

Bridges are sometimes the best alternative for crossings. These structures should be approved by a registered engineer. They are the most expensive crossing to build but might have the lowest annual maintenance cost. Bridges can be expected to last from 10 to 30 years if the material is peeled and about 5 years if the material is not peeled. Treated timbers can be expected to last from 30 to 45 years and steel or concrete should last from 50 to 60 years. The number and size of the stringers used will depend on the load the structure will be required to hold. In snow areas, the bridge is normally constructed to withstand a maximum snow load which is generally larger than any load placed on the structure from livestock. The table below gives general guidelines on the number and size requirements for stringers:

Bridge Stringer Size Requirements

Span feet	3 Stringers sawed	3 Stringers round	4 Stringers sawed	4 Stringers round	5 Stringers sawed	5 Stringers round
	inches		inches		inches	
8	3 x 6	6	3 x 6	5	3 x 6	5
10	3 x 6	7	3 x 6	6	3 x 6	6
12	3 x 8	7	3 x 8	7	3 x 8	7
14	4 x 8	8	3 x 10	8	3 x 8	8
16	4 x 10	9	3 x 10	8	3 x 10	8
18	6 x 8	10	3 x 12	9	3 x 12	9
20	6 x 10	11	3 x 12	10	3 x 12	10
22	6 x 10	11	4 x 12	11	4 x 12	10
24	6 x 12	12	6 x 12	12	6 x 12	11
26	6 x 14	13	6 x 12	12	6 x 12	12
28	6 x 14	14	6 x 14	13	6 x 12	13
30	6 x 16	14	6 x 14	14	6 x 14	13
32	6 x 16	15	6 x 16	14	6 x 14	14
34	---	16	8 x 16	15	6 x 16	15
36	---	16	8 x 16	16	8 x 14	16

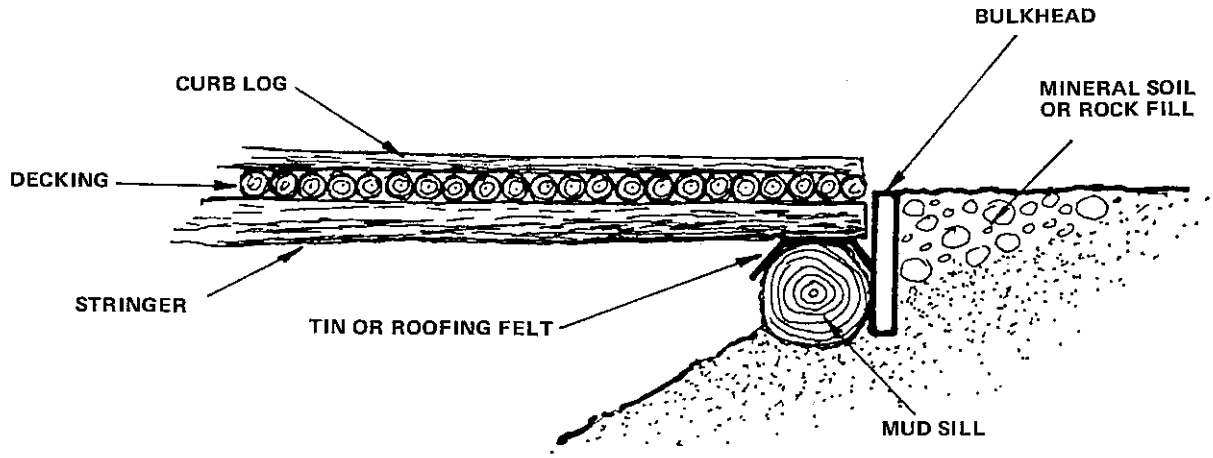
The table is based on a maximum bending stress of 900 pounds per square inch round timbers, and 1,200 pounds per square inch for sawed timbers. Allowable shear stress for all timber is 120 pounds per square inch. Structures are designed to carry a uniform load of 400 pounds per linear foot of span.

The stringers sit on a mud sill constructed of round on-site material or sawed material. Some builders use 55-lb roofing felt or tin between the stringers and the sill to divert run-off from the sill. But, felt and tin trap condensation on top of the sill, which promotes decay.

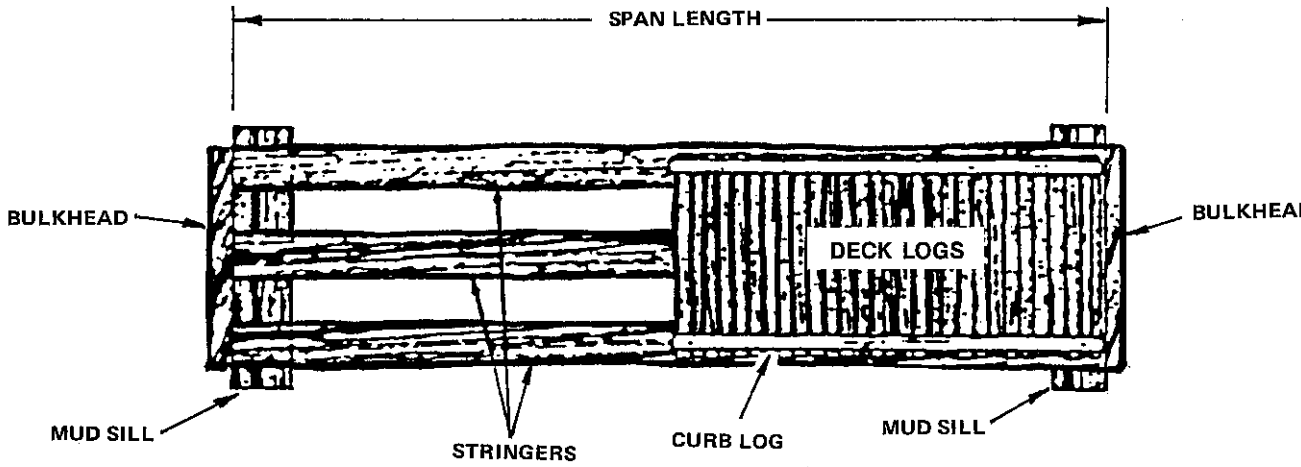
Decking is nailed on top of the stringer to provide a walking surface. Decking can be constructed of sawed material, split logs, or round material. Round decking is sometimes used and 3 x 12-inch planks are spiked on top of the decking as the actual surface. Construction will depend on the amount and kind of traffic on the bridge. For example, shod horses will cause more wear on the walking surface than sheep. For horses, it may be better to put the sawed-tread surface on top of the decking. Round material should be hewn to provide a flat surface. A curb or hand rail on the side provides security.

Dirt provides a secure tread surface. It does however promote decay. A dirt tread surface is recommended for bridges with high use in frosty or wet areas.

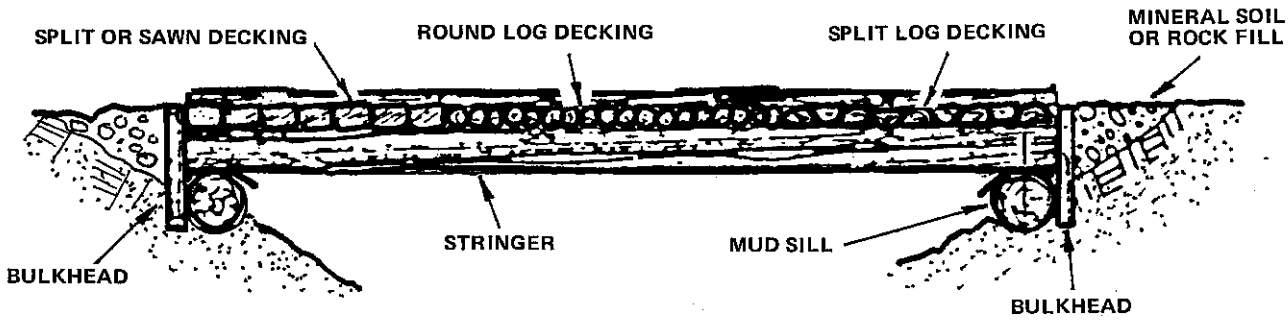
A bulkhead should be attached to the mud sill and should extend up even with the decking. Fill material will be leveled up against the bulkhead as high as the decking material to provide a level surface from the trail approach onto the bridge decking. This reduces tripping.



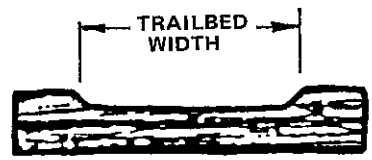
Log bridge



PLAN VIEW



SIDE VIEW



HEWN ROUND LOGS OR ROUND PORTION OF SPLIT LOGS TO PROVIDE FLAT SURFACE FOR TRAIL TREAD

TRAIL TREAD DETAIL

Log bridge

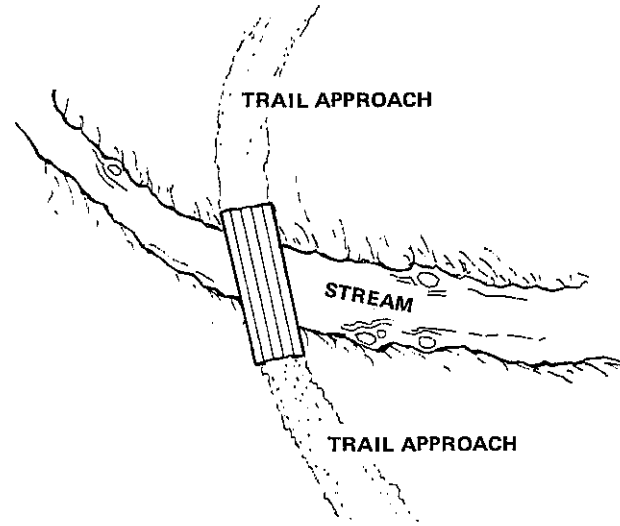
Some livestock will cross easier if there is a ramp onto the bridge. This can be constructed of decking material. Nail cleats to the ramp to provide traction. Cleats can be made of split round material, or sawed 2 x 4-inch or 4 x 4-inch material. They are placed 16 to 18 inches apart. Cleats must be checked annually for wear. Replace them when they are worn or broken.

The approach to the bridge should be straight. The bridge may need to be skewed to give a straight line of approach. This prevents livestock from bunching up or not crossing the bridge at all.

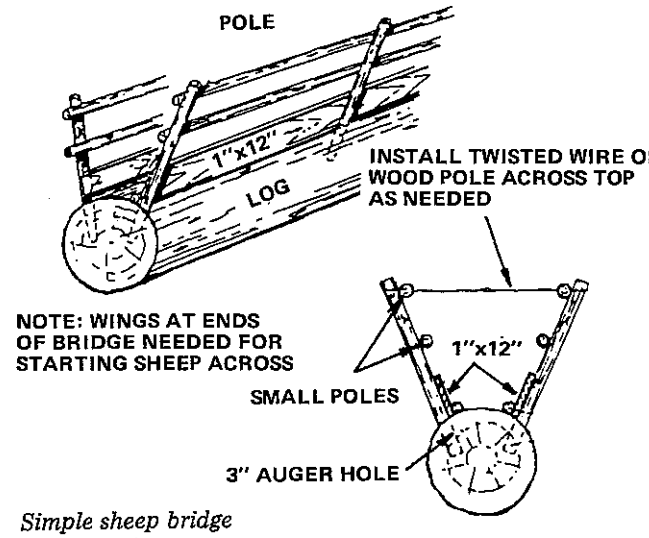
The approach should not be steep. Retaining walls should stabilize the banks. Preserve the trail by using water bars and open tops to keep water off the trail surface. A simple sheep bridge can be constructed from a log with rails on the side. The log should be of sufficient size to provide a good tread surface. The top of the log should be flattened as a level walking surface. The rails will be fastened to the log by drilling holes in the log and inserting poles into the holes where the side rails can attach. These temporary bridges are simple and inexpensive to build.

These temporary bridges are simple, inexpensive to build, and are constructed of native materials.

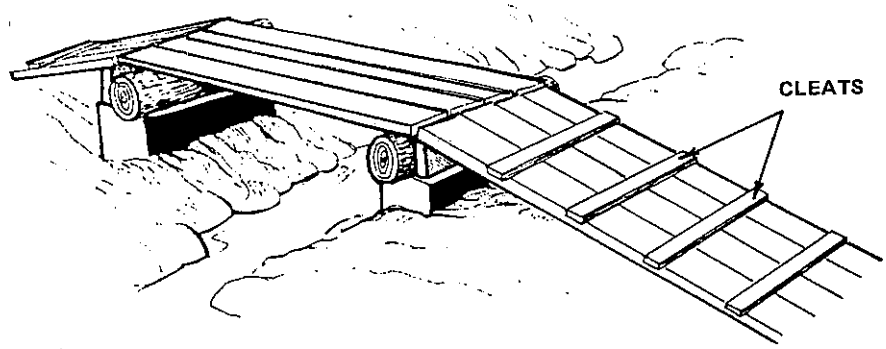
Another possibility is prefabricated bridges. They are economical, time-saving, and come in a variety of designs. These bridges are manufactured to your specifications and shipped to the site for easy construction. As with all permanent bridges, a bridge design engineer should be consulted when ordering these bridges.



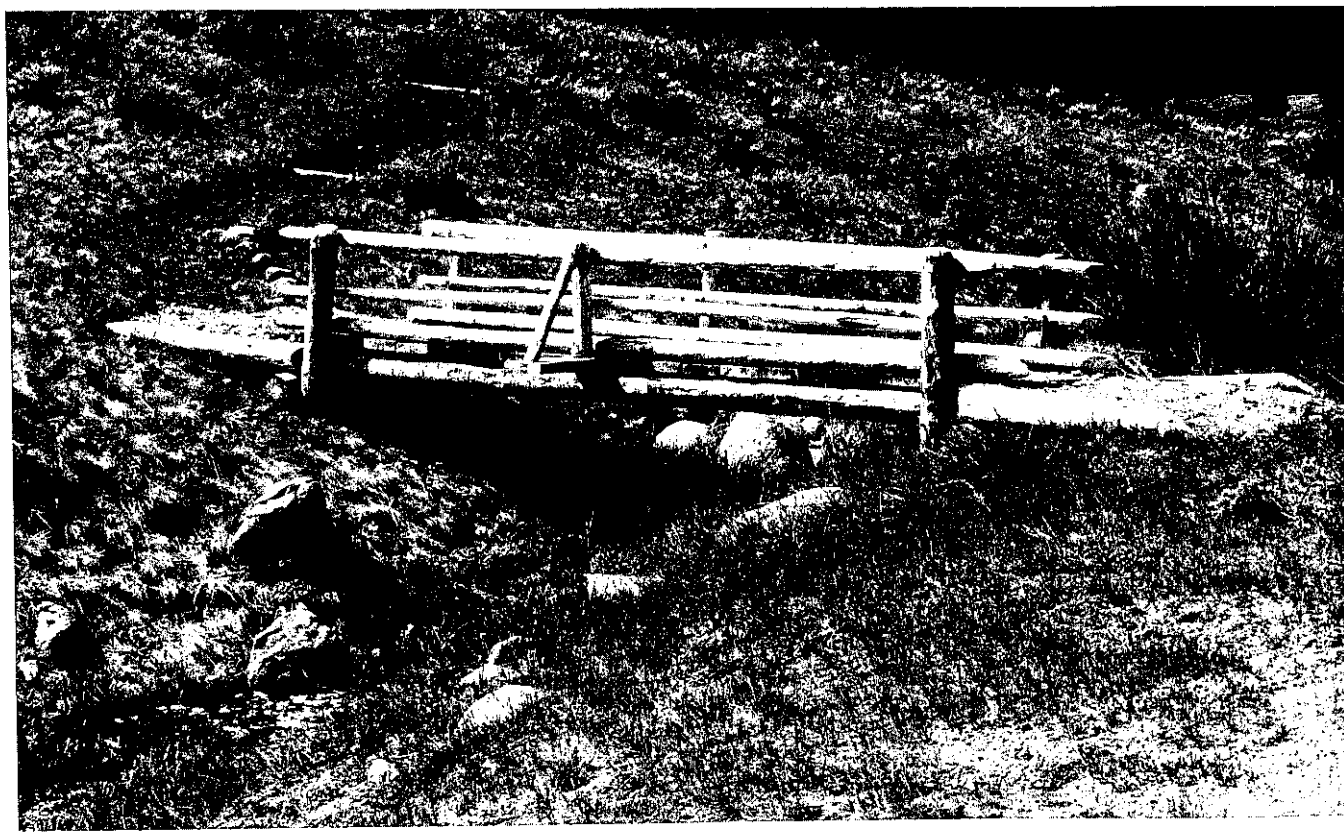
Skewed bridge to allow straight approach



Simple sheep bridge



Bridge with ramp



Examples of livestock bridges

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Photo courtesy Montana Historical Society, Helena, MT

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