Chapter 10
Safety and Animal Handling

10.1 Introduction

Stockmen working in animal housing and associated handling facilities are exposed to a number of potential risks and health hazards. Many stockmen work alone, handling big, sometimes dangerous animals as well as large groups of animals. Several work tasks involve daily lifting, carrying of heavy loads and awkward working postures, which may cause overload injuries on the worker's musculoskeletal system. Other potential risk factors contributing to accidents as well as to physical health problems and physiological stress for the worker is the fact that they operate in an environment where they are exposed to airborne particles, gases, noise. The work environment is partly the same environment, which is provided for the animals, and it should be noted that there is a strong relationship between the animal welfare issues and the handling of the work environment problems in cattle houses.

10.2 Health and Injuries Among Livestock Farmers

10.2.1 Accident agents

In an accident situation there is a complex interaction between man and injury agents. In animal husbandry the human is subjected to a high degree of exposure to a large number of factors that singly or in combination can be accident provoking, such as animals, equipment and building structures. Risky situations are often due to wet and slippery floors as well as systems for material and animal handling.

10.2.2. Prevention of accidents

With reference to accident statistics some accident preventing facilities and measures can be listed:

- Good cattle handling and handling facilities (Section 10.3)
- Pens from which the herdsman can easily escape if necessary in case of for instance frightened cattle and aggressive bulls
- Personnel passages through yard fences, properly placed
- Wide feeding passage or possibility to shut out the cattle from the feeding area
- Non slip flooring (see Chapter 4)
- Satisfactory lighting considering quality and quantity (Table 10-1)
- Well designed ladders and stairways
- Protective railings around the fodder hay-chute in two storey houses
- Handles and bolts that do not stand out in alleys and pathways
- Protectors for the knuckles on barrows
- Emergency stops on machinery

Table 10-1: **Recommended illumination level for different work areas in buildings used for beef production. Lux values refer to the work plane. In addition to the quantity, the quality of light (i.e. colour of the light source, uniformity of illumination and glare) must be considered**

Building or work area/Task	Intensity of illumination, lux
Animal housing area	150
Animal handling area	250
Veterinary treatment	1 000
Feed processing, feed alley	250
Silo, feed storage	100
Ladders and stairs	250

10.2.3 Ergonomics

Any normally fit adult person, regardless of sex, physical strength and body dimensions should be able to work comfortably in livestock buildings. Despite an increasing degree of mechanisation and automation many jobs in animal husbandry are still associated with lifting heavy loads, moving and carrying equipment, feed and other materials with manual methods. An important step towards improved human welfare within cattle housing is to eliminate unnecessary loads on the human musculoskeletal system.

10.2.4 Health aspects related to air quality

It has been known for decades that farm workers suffer health risks due to inhalation of gases and airborne particles commonly referred to as dust. The particles may be liquid droplets or solid. Several respiratory disorders have been reported, which are associated with dust and work in confined livestock buildings such as hypersensitivity, pneumonia, acute inflammation, chronic bronchitis, occupational asthma and toxin fever. The respiratory problems connected to gases range from mild irritations of the respiratory tract to lethal effects. For the most frequent components in the air environment in livestock buildings there are statutory threshold limit values, which differ from country to country.

It should be noted that threshold limit values in connection with animal welfare in many countries often are lower than the work environment legislation.

10.2.5 Dust and dust reducing

Dust in animal houses is generated inside the building and arises primarily from the animals and bedding and feed material. The airborne particles are often carriers of biologically active material like endotoxins, pathogens and allergens that can highly be disease provoking. Of special interest is the concentration (i.e. number of particles per air volume) of respirable particles with a diameter less than 5 µm that can be inhaled and deposited in the lung. The smaller particle the higher possibility that the particle reaches the lower respiratory tract and the deeper the particle is deposited the higher is the risk for illness. Even if "common dust" can be seen by human eyes (larger diameter than 100 µm), the very small respirable particles cannot be, so we are indeed dealing with a danger our senses are not able to detect.

There are basically four approaches that can be used for airborne dust reducing:

- Prevent particle formation
- Prevent particle release
- Remove suspended particles from enclosed workspaces
- Isolate workers from dust clouds in workspace.

Of course the best approach in this matter is to have the cattle and the working sites outdoors or in open barns. In the cattle barn the most effective way to obtain a low dust concentration level is to prevent formation by always using hygienically perfect forage and bedding material. Providing an effective ventilation system in a barn is a good practice to remove suspended respirable particles as well as gases.

10.2.5 Gases and reduction of gas levels

In animal buildings over 150 different gases and volatile compounds have been identified. Most of the volatile compounds originate from biodegradation of animal excreta or are produced by the animals themselves such as carbon dioxide (by the respiration of the animal). The gases that are found in the highest elevated concentrations are ammonia, carbon dioxide, hydrogen sulphide and methane. ***It must be emphasised that it is dangerous to enter any manure tank*** without either using a self-contained air supply or combining several measures: testing the air, constant and adequate ventilation of fresh air and using an harness and lifeline on the person entering the tank. As well, human and animals positioned over a slatted floor with manure storage underneath are at risk during agitation, mixing or pumping of manure due to the gases, especially hydrogen sulphide. A good strategy is to evacuate dangerous zones during these manure-handling actions.

Ammonia: Ammonia is the most common polluting gas in the atmosphere of the cattle barn. Animal manure is the main source of ammonia. The gas together with hydrogen sulphide a major component in what is termed odour, noticeable at ammonia concentrations of 5 ppm or more. Higher concentrations than that cause irritation to the respiratory organs and can aggravate the negative health effects of high dust concentra-tions.

Many factors affect the emission and concentration of ammonia such as air flow rate, manure and air temperature, manure surface area, density of animals, the degree of mixing of urine and faeces, time intervals between manuring, the pH-value, carbon/nitrogen ratio, mois-ture content and type of bedding. Consequently, many measures can be taken such as: proper ventilation and sufficient number of air changes, low air temperature in the barn and good urine drainage characteristics of the floor.

Hydrogen sulphide: Hydrogen sulphide is the most toxic gas in animal confinement houses and 200 ppm and more are lethal for humans. The presence of the gas is of concern in buildings with liquid manure systems particularly. During slurry clearing operations concentrations in the range of 1 500 to 2 000 ppm have been reported.

Since hydrogen sulphide is lethal the aim should be to keep it below detectable concentration at all working sites. Special care has to be taken when pumping or agitating the manure. During emptying a slurry cellar the workers and the animal should be evacuated from the barn. In mechanical ventilated, closed animal houses continuously evacuation of the gases in an indoor slurry pit through a perforated duct under the floor and along the pit can reduce the gas concentrations above the slatted floor. By removing the slurry daily from the cattle barn to an outdoor storage it is possible to hold the concentration at an accept-able level.

Methane: Methane is generated when manure is stored under anaerobic conditions. This occurs in all non-aerated manure storages. Primarily, methane is dangerous because of its flammability. If methane is mixed in a proper proportion with oxygen a spark will be able to set off an explosion.

Carbon dioxide: Carbon dioxide is present in all air, indoor as well as outdoors. Only extremely high concentrations (70 000 ppm or 7% and over) could have severe health effects. Mostly, incidents and accidents involving carbon dioxide are connected with asphyxiation due to oxygen deficiency rather than the direct effect of carbon dioxide itself. For instance, it is dangerous to enter a haylage silo during storing. In animal buildings the gas is more an indicator of ventila-tion efficiency than a health risk.

10.2.6 Noise

Noise can be defined as ”unwanted sound, rapid, annoying pressure vibration in the surrounding air”. Ventilation fans, grinders, vacuum pumps and mechanical feeding and manure systems generate noise. High sound levels are a real stress factor. Exposure to noise will be able to cause temporary deafness and permanent hearing loss after a variable period if the level is over 85 dB(A). The unit, dB(A), is exponential and the human sense of hearing will perceive the sound level as halving if a reduction of 10 dB(A) occurs. It is fairly easy to reduce the sound level of ventilation fans and other mechanical noise generators. Maximum noise level recommendations and regulations differ from country to country.

Furthermore, it is important to reduce noise when handling cattle in order to improve animal movement and to make cattle handling safer. Cattle are more sensitive to high frequency noise than human. Animals will be calmer and easier to handle, if noise level is reduced. Clanging and banging metal parts should be silenced with rubber pads. Equipment operated with hydraulics should be engineered for quietness.

10.3 Cattle Handling and Cattle Handling Facilities

Handling facilities are an essential part of a safe, easy and rapid handling of cattle. Appropriate handling and handling facilities remove much of the stress and frustration of the workmen, which inevitably occurs with excited, stubborn or aggressive animals. Properly constructed facilities confine cattle safely and efficiently with minimal animal stress and risk of injury to both cattle and workers.

10.3.1 Animal behaviour and improving animal handling

Understanding cattle behaviour can help farm workers to avoid dangerous situations and minimise accidents to handlers, as well as to design the handling facilities appropriately. Animals have natural boundary called the Flight Zone (*Figure 10-1*). Deep penetration into the Flight Zone can cause panic and escape attempts. Handlers should have the possibility to remove, and should remove themselves from the Flight Zone, if the animal becomes aggressive.

To move an animal forward: stand in the shaded area position B, behind the Point of Balance at the shoulder. Keep out of

the Blind Spot at the rear of the animal. To stop movement: back off to position A. To make an animal back up: stand in front of the Point of Balance. To make an animal turn left or right: approach the animal head on. Factors reducing an animal's Flight Zone size: frequent contact with people; history of gentle handling; calm environment. Factors enlarging the Flight zone: infrequent contact with people; history of rough or abusive handling; excitement.

To improve animal handling and animal movement, many technical measures can be taken such as:

- Appropriate handling facility design (Section 10.3.2).
- Animals tend to move from a dark to a more brightly lighted area. The light should illuminate the chute up ahead. Eliminate shadows and patches of light and dark, which may confuse animals. An approach is to illuminate the entire working area. Lamps should not shine into the eyes of approaching animals because glaring and blinding light impedes movement. Illumination should be uniform and diffuse.
- Prevent distractions, such as a chain hanging down in an entrance. Avoid sparkling reflection in a puddle, a moving reflection on a sheet of metal or bars of shadow across an otherwise sunlit alleyway. Dark colours can create shadow effects. Bright colours such as white and light yellow have been proven satisfactory.
- Reduce noise (Section 10.2.6)
- Animals might refuse to move, if they can see people ahead. Install shields to prevent animals from seeing farther ahead. Gates can be rigged with motor controls so a handler standing behind the cattle can open them.
- Solid sides that prevent the cattle from seeing outside the fences should be provided in the races and crowding pens. The crowding gate on the crowding pen should be solid as well, preventing animals from attempting to turn back to were they come from.
- Cattle are sensitive to changes in type and texture of floors and fences. Changes in type of flooring can cause balking. Use the same type of flooring throughout a facility, if possible. Use non-slip flooring. Drains should be located outside main drive alleys, chutes and crowd pens.

10.3.2 Cattle handling systems

A handling system has three main purposes: to sort, handle and treat cattle. The parts and the requirements of a system are (*Figure 10-2*):

- **Collection alley** to move cattle from the cattle house, pasture or feedlot to the holding pen
- **Sorting pens**. Opening off the collection alley or holding pens, or after the working area
- **Holding pens** to hold either the whole herd or groups of 30 -50 heads
- **Crowding pen** to move small groups of 8 – 10 cattle into the working area
- **Single file race**, at least 6 m long to hold 3 – 4 cattle at once
- **Loading chute**
- **Crush**, preferable type "walk-through" and with a self-locking head-gate
- **Options** such as scales, calf crush or table, belly clipping crush, crush equipped for claw-trimming, access kiosk for artificial insemination and gynaecological examinations, shelf near the crush for veterinarian's equipment and materials, the availability of hot and warm water near the crush

The current trend in the design of cattle working facilities is to use circular crowding areas and working chutes (*Figure 10-3*). The circular designs take advantages of cattle's tendency to circle and crowd towards the outside of a curved passage. Cattle can normally be worked in less time with a round crowding pen and a curved race than a straight one. Round crowding pens should be laid out so the cattle make a 180° turn as they move though the crowding pen.

However, a straight-line designed (*Figure 10-5*) as well as a corner located working unit (*Figure 10-7*) are area saving alternatives, especially valid for small herds of cattle and indoor, respectively.

Some corral and working facility dimensions are given in *table 10-2*.

Some facilities and detailed solutions improve the human safety in cattle handling systems:

- **Catwalk** around the crowding pen, and working and loading chute allows the

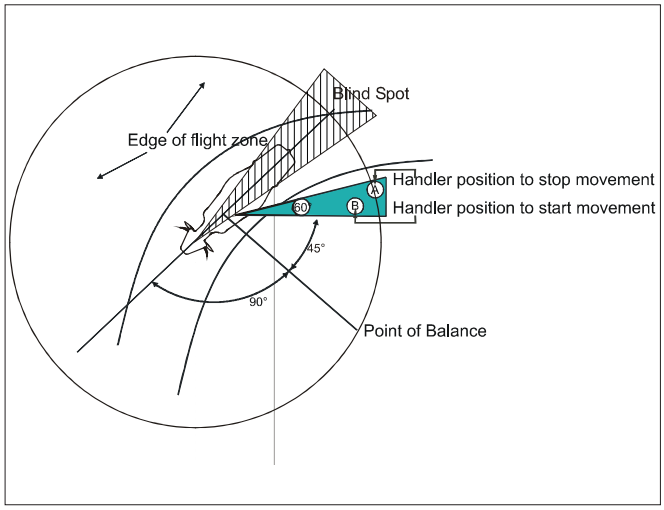

Figure 10-1: **The flight zone of animals (GRANDIN, 1999a).**

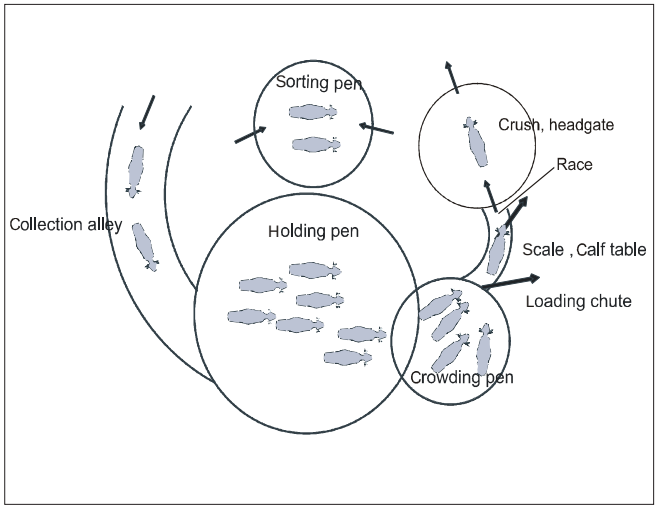

Figure 10-2: **Components of a cattle-handling system (BORG, 1994).**

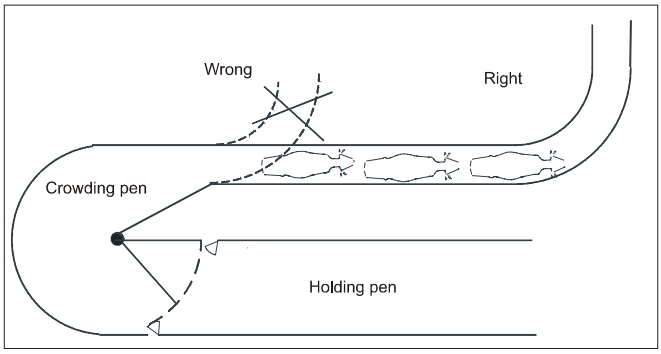

Figure 10-3: **Layout for a curved handling system. If the single file race is bent too sharply where it joins the crowding pen, the cattle may refuse to enter, because it looks like a dead end. Cattle standing in the round crowding pen must be able to see a minimum of three body lengths up to the single file chute before the curve begins (GRANDIN, 1999[b])**

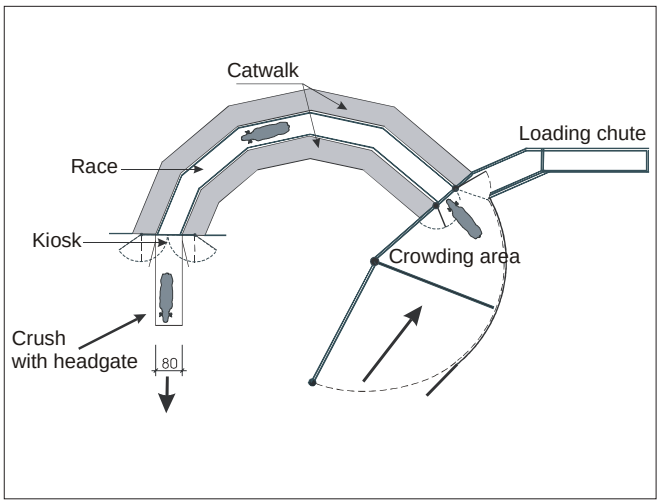

Figure 10-4: **Basic Layout for a working unit**

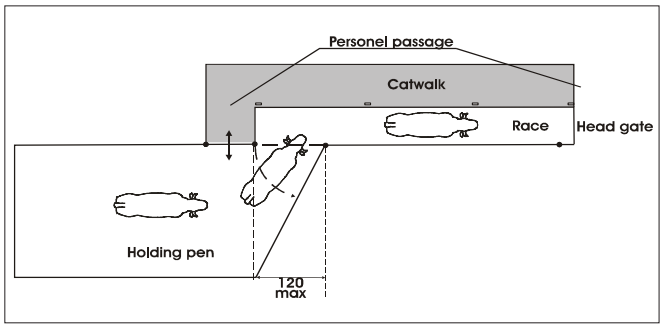

Figure 10-5: **A straight-line designed working unit (Institut de l'Elévage & Mutualité Sociale Agricole, 1993).**

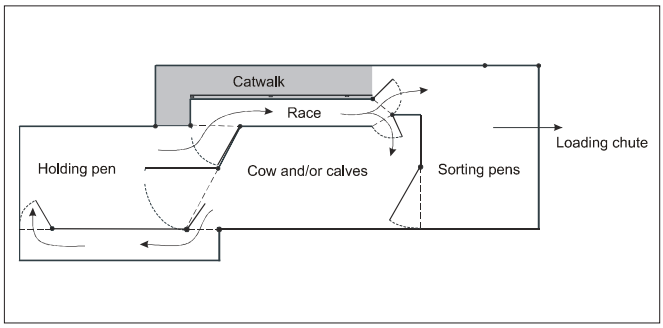

Figure 10-6: **A sorting unit, for instance for a suckler herd (Institut de l'Elévage & Mutualité Sociale Agricole, 1993).**

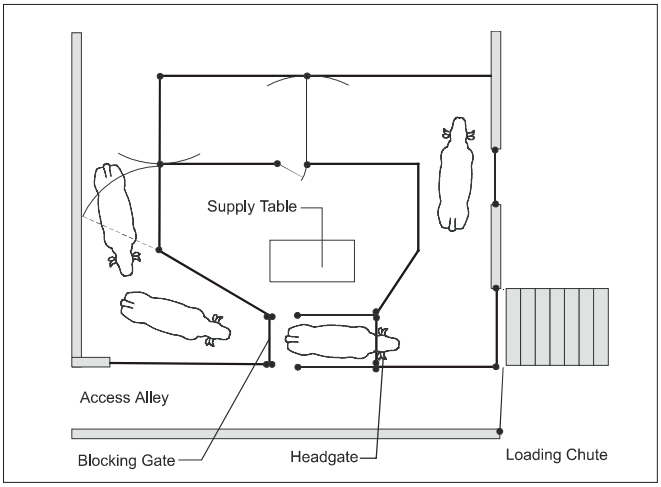

Figure 10-7: **A corner located working unit (BICKERT et al., 2000)**

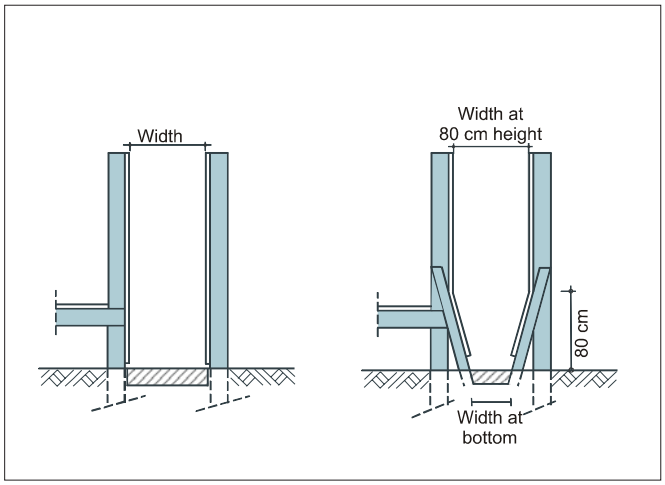

Figure 10-8: **Straight sided (left) and half tapered (right) race design. The width, the width at 80 cm height and width at bottom are given in table 10.2., Tapered race allows working with different animal size, but involves risk to get stuck if animals lie down in the race.**

Table 10-2: **Corral and working facility dimension. L, W and H, respectively in the equations correspond to body dimensions of beef cattle according to Chapter 3. Dimensions of facilities related to animal size are calculated from CIGR standard (*Table 3-1*)**

		Animal Size, kg					
	Equation	200	300	400	500	600	700[a]
Pen Space							
Holding pen, held overnight, m²/head	HA_{on}= 6*L*W	2,4	3,1	3,9	4,6	5,2	5,9
Catch or holding pen[b], m²/head2,3	HA = 2,3*L*W	0,9	1,2	1,5	1,8	2,0	
Crowding pen, m²/head	CA = 1,4*L*W	0,6	0,7	0,9	1,1	1,2	1,4
Race with vertical sides							
Width, m	WR = 1,3*W	0,44	0,52	0,60	0,66	0,71	0,78
Length (minimum), m	LR = 4,2*L	4,9	5,5	6,0	6,3	6,7	6,9
Race with sloping sides							
Width at bottom inside clear, m	WR_b = 0,85*W	0,30	0,35	0,40	0,43	0,47	0,51
Width at 80 cm height inside clear, m	WR = 1,3*W	0,44	0,52	0,60	0,66	0,71	0,78
Length (minimum), m	LR = 4,2*L	4,9	5,5	6,0	6,3	6,7	6,9
Race fence							
Height (minimum), m	HR = 1,15*H	1,25	1,36	1,46	1,53	1,59	1,63
Corral fence							
Height, m	HC = 1,25*H	1,36	1,49	1,59	1,66	1,73	1,78
Loading chute							
Width, m	WL = 1,4*W	0,48	0,56	0,64	0,71	0,77	0,84
Length (minimum), m		3,7	3,7	3,7	3,7	3,7	3,7
Rise (maximum), m/m		0,25	0,25	0,25	0,25	0,25	0,25

[a] including cow-calf operations
[b] worked immediately

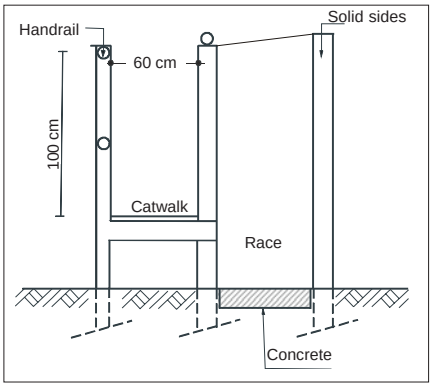

Figure 10-9: **Cross-section of a catwalk with handrails.**

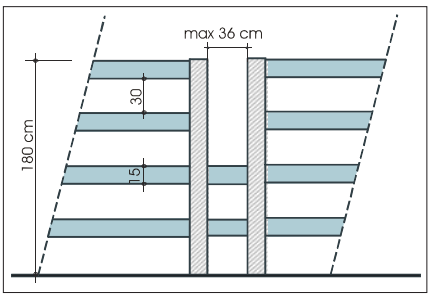

Figure 10-10: **A personnel passage of a wooden yard fence.**

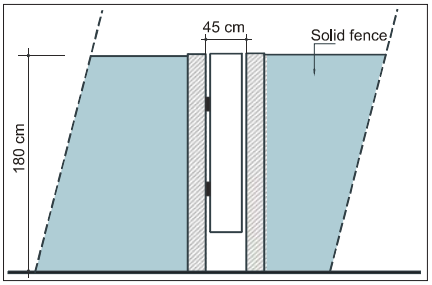

Figure 10-11: **A personnel gate in a solid yard fence**

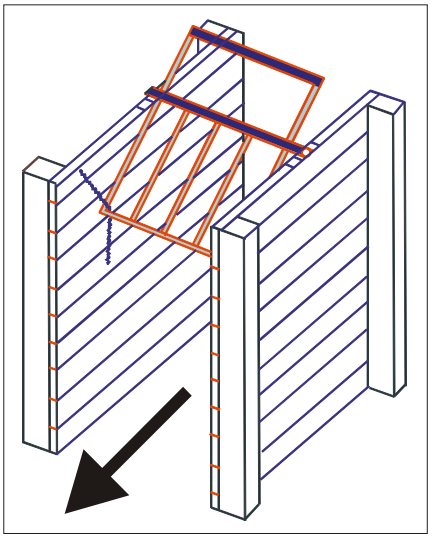

Figure 10-12: **One type of a one-way gate (BORG, 1994).**

handler to see over a high, solid fence, follow the cattle and manoeuvre animals while avoiding direct animal contact. The catwalk should be minimum 60 cm wide, or wide enough to provide a comfortable surface. The catwalk height should be 90 – 110 cm below the top of the fence or at belt buckle height, if one stands on the catwalk. With any less, there is a danger of toppling into the pen or race. Access to the catwalk should be provided by steps. Catwalks and walkways that are more than 60 cm off the ground should have handrails for worker safety (*Figure 10-9*).

- **Optional footholes/toe slots or escape boards/rails** along solid sides inside pens at a 60 cm height will make toe ledges, if one has to make a quick exit from the pen. High solid fences (over 180 cm high) should have grab rail to facilitate the escape.
- **Personnel passages,** 36 cm wide, well placed in yard fences for hasty retreat. The two plank pieces in *Figure 10-10* in the gap are intended to keep calves inside the fold, but the planks can be designed to be removable.
- **Personnel gates**, 45 cm wide, spring loaded, no latches, open inward toward the cattle. Personnel escape gates are especially important in confined areas with solid fences such as the crowding pen where the handler may be deep in the animal's flight zone (*Figure 10-11)*.
- **One-way gates,** to prevent cattle backing in the race (*Figure 10-12*) are a safer alternative to pipes placed behind animals in the race. If backstops are not installed and pipes must be used, be sure the pipe is between the cattle and worker. If not, a worker can be caught between the pipe and the chute or fence if the animal backs up before the pipe is extended through the race. One-way gates should be adjusted to block an animal 15 – 20 cm below the top of the tail head. How-ever, too many backstop gates may cause balking and stop cattle movement through the facility. Install the one-way gate at least two body lengths up the race beyond the crowding pen, or let the one-way gate at the entrance be either tied open or remote controlled so it can be open as the animals enter.

- **Special bull pen** with several personnel passages (*Figure 10-13*)
- **Hydraulically powered restraint equipment** often is safer than manually operated facilities, because protruding lever arms are eliminated. In addition, a well-designed hydraulic crush takes less effort to use, is faster and sturdier than a manually operated crush. However, the pressure relief valve must correctly be set. Extreme pressure can cause severe injuries to both people and animals.
- **Latching devices** and protruding lever arms cause many injuries and are commonly described as "head-knokkers" and "jaw-breakers". To decrease the accidents, it is important to keep the latching devices well maintained and to avoid lever arms that protrude too long.
- Veterinarians performing rectal palpation might be injured, if a cow lies down and jams veterinarians arm. Use restraining methods that help circumvent this problem, e.g. types of **head gates** that reduce the risk of animal choking and going down.
- Accidents occur when treating animals, which are caught around their hips by the head gates. To reduce the temptation of working on an animal that is half out of the crush, install a **sorting gate in front of the crush** and a separate holding pen. Then the animal is easily moved back through the crush for reworking.

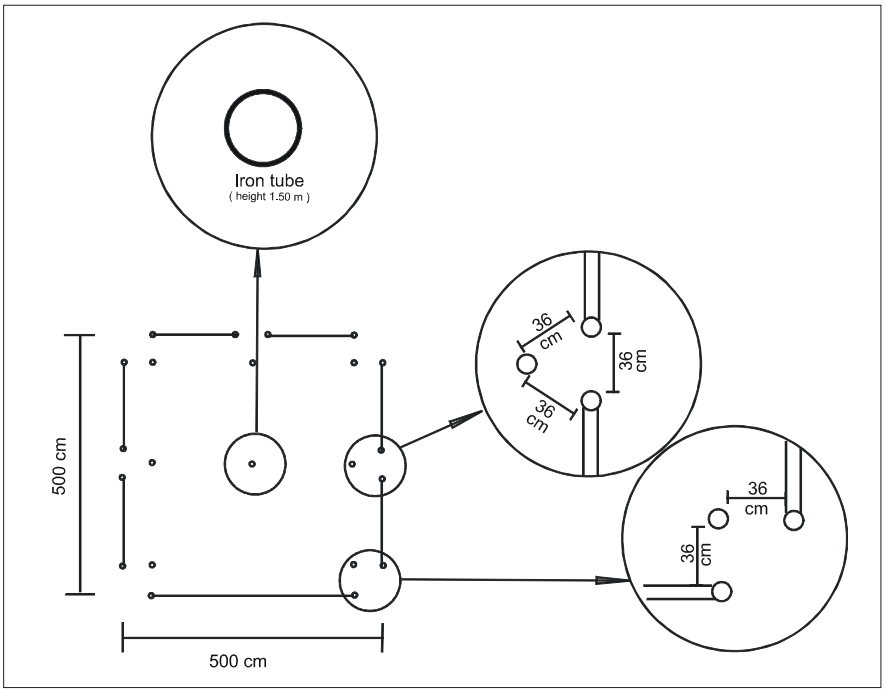

Figure 10-13: **Bull pen with personnel passages and a central column.**