



**Centurion**  
**UNIVERSITY**  
*Shaping Lives...*  
*Empowering Communities...*

# **AGRICULTURAL STRUCTURES AND ENVIRONMENTAL CONTROL BTAP3105**

## **DAIRY BARNS**

**SUDIPTA BEHERA**  
**ASSISTANT PROFESOR, SoABE**



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

# INTRODUCTION

## DAIRY BARNES

An efficient management of cattle will be incomplete without a well-planned and adequate housing of cattle. Improper planning in the arrangement of animal housing may result in additional labour charges and thus curtail the profit of the owner.

### **Selection of Site for Dairy Farm:**

- ✚ Topography
- ✚ Soil Type
- ✚ Exposure to the sun and protection from wind
- ✚ Accessibility, Durability and Attractiveness
- ✚ Water Supply
- ✚ Surrounding
- ✚ Labour
- ✚ Marketing
- ✚ Electricity



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

## Types of Dairy Barns:

There are three general types of dairy barns:

- ✚ Stanchion barn
- ✚ Loose housing barn with milking parlour
- ✚ The open air barn





**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

## Stanchion barn:

- ✚ In this barn, the cows are housed and milked in the same building. It is also called the general purpose barn of the cow house system of arrangement.
- ✚ Individual feeding and management of animals are possible. For eight or more cows a two row barn with either face in or face out arrangement may be selected.
- ✚ The face out type barn is preferred for milch animals and also whenever the barn is to be enclosed. This arrangement is important since most of the jobs are done from the rear of the animals, and provides easy supervision. Such barns are commonly built 10-11 m wide, with sufficient length to accommodate all the animals.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities*

- ✚ The manure alley can be eliminated in the face in type, since the open space outside the barn can be used for the purpose.
- ✚ This gives a saving of about 20 per cent in floor area of barn a compared to the face out type.
- ✚ Face in type barns are usually preferred for bullocks and also for open sheds type arrangement.
- ✚ The maximum length of the barn should be restricted to 40 m so that nearly 72 cows can be housed in one barn unit.
- ✚ Gutters are usually 45 cm wide and 15 cm deep.
- ✚ A minimum slope of 2% should be provided so that the gutter may drain into a manure pit outside the barn.



Centurion  
UNIVERSITY

Shaping Lives...  
Empowering Communities

**Mangers** used in barns should have widths ranging from 75 to 90 cm. The back of the manger is about 60 cm above the floor so that cows may throw the fodder into the feed alley. The length of the manger for individual cow is equal to the width of the stall and may demarcated by a 12.5 cm high wall.

**Feed alley** 1.2 m wide is sufficient. It is the passage between the outer wall and the manger along which a pushcart full of silage may be moved.

The height of the walls running along the barn length may be about 2.4 m. For gable roof, the maximum height of the ceiling may vary between 5 and 5.5 m for a barn 10 to 11 m wide.

For adequate lighting in the barn, 0.37 sq. m of window area per cow is desirable.



Centurion  
UNIVERSITY

*Shaping Lives...  
Empowering Communities...*

# DESIGN ASPECTS

**Stall size:** The size of stall depend upon the size and age of animals. Narrow and cramped stall should be avoided, as it restricts the movement of animal resulting in discomfort and even injury to the animal which will affect the milk yield. As the size old cow varies with different breeds, a general space requirement of each type of the basis of its weight is given in the following table :-



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

Weight of cow		Girth (per meter)		Stall width		Stall length	
Kg	lb	cm	inch	cm	feet	cm	feet
<b>363</b>	800	162.5	65.0	100.0	3'4"	135	4'6"
<b>454</b>	1000	176.2 5	70.5	110.0	3'8"	140	4'8"
<b>544</b>	1200	187.5 0	75.0	120.0	4'0"	150	5'0"
<b>634</b>	1400	198.7 5	79.5	130.0	4'4"	160	5'4"
<b>723</b>	1600	210.0	84.0	140.0	4'8"	170	5'8"



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

**Mangers** : are feeding structures for the animals. The size of the mangers should be sufficient to hold the feed. It should, be sufficient to hold the feed. It should be shaped in a curved form so that no wastage of feed is figures.

The low manger known as “sweep in” is simple and easy to construct and it affords facility for quick feeding. The waste thrown by the animal away from the manger can easily be swept back. The high front manger, though a bit difficult and costlier in construction, is still adopted of less wastage by throwing the feet out of mangers. The usual width of manger varies from 60 cm to 90 cm. The back of low manger is flush with feeder alley and the back of height front manger is about 70 cm above the feeder alley.

At the foot of manger a stanchion curb of height 12.5 cm is provided to prevent the animal from dragging the feed into the stall. This curb separate the manger and the stall and provides support for the bottom of stanchion.

Cement concrete tubes of 150-200 liter capacity are provided in between two cows.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

**Space for pathways:** To increase the efficiency of dairy management enough space for pathways should be provided for conveying feed to the manger, milking the cows and removing the manure waste etc. The pathways provided in a stanchion barn are feed alleys and litter alleys. Feed alleys are pathways provided between two rows of mangers in case of face in system or pathways between the mangers and side wall in the case of face out system. the usual space left is 1.2 m so as to allow the conveyance of feed in a push cart. In the case of big dairy barns the should be wide enough for a farm cart drawn by bullocks or farm tractor. In the case of face in arrangement no separate litter alley is provided as the sides are not enclosed. But in face ant arrangement litter alleys are provided for a width of 1.8m to 2.4 m for facility of milking and taking out animals. Cross alleys are also provided where the number of animal are more to have access from one side to the other without back tracking.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

**Cutters:** these are provided to convey the animal waste and to drain urine and wash-water to manure pits provided out side the dairy barn. These are provided by the side of litter alleys and their width varies from 40cm to 45cm and the depth is 15 cm. A minimum bed slope of 2% should be given for the gutters to drain without any stagnation.

**Flooring:** The flooring for dairy barns may be laid either with cement or lime concrete as sub grade, with a meet rough finish on top with c.m. The stall platforms should be sloped well for maintaining the clean liners. The top surface of the flooring should not be left smooth as it may cause slipping of animals. Thread linings. Made on the floor renders grip to the animals. A toe hold known as toe drain provided at the front of the stall for 1/3 length helps the animals to sit or stand without slipping.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

**Walls :** Brick or rubble masonry in lime or cement mortar can be adopted for enclosing the barn. The length should be a minimum of 2.4m. Ventilators or opening of 0.37 sqm (4 sq ft) per each cow should be provided to give natural lighting & air. If climate and environment do not call for enclosures, pillars at 2.4m to 3m apart (8 to 10 ft) can be had to support the roof.

**Roofing:** In hot regions, tiled roofing can be advantageously adopted rather than A.C. sheet or other corrugated sheet roofing, because of its less heat radiation. A.C. sheet can be adopted where the temp is moderate. Concrete roofing is the best, if the investment is justifiable. In the case of two rows. Barns, roof trusses of iron or timber should be used, since the width will be more than gm.

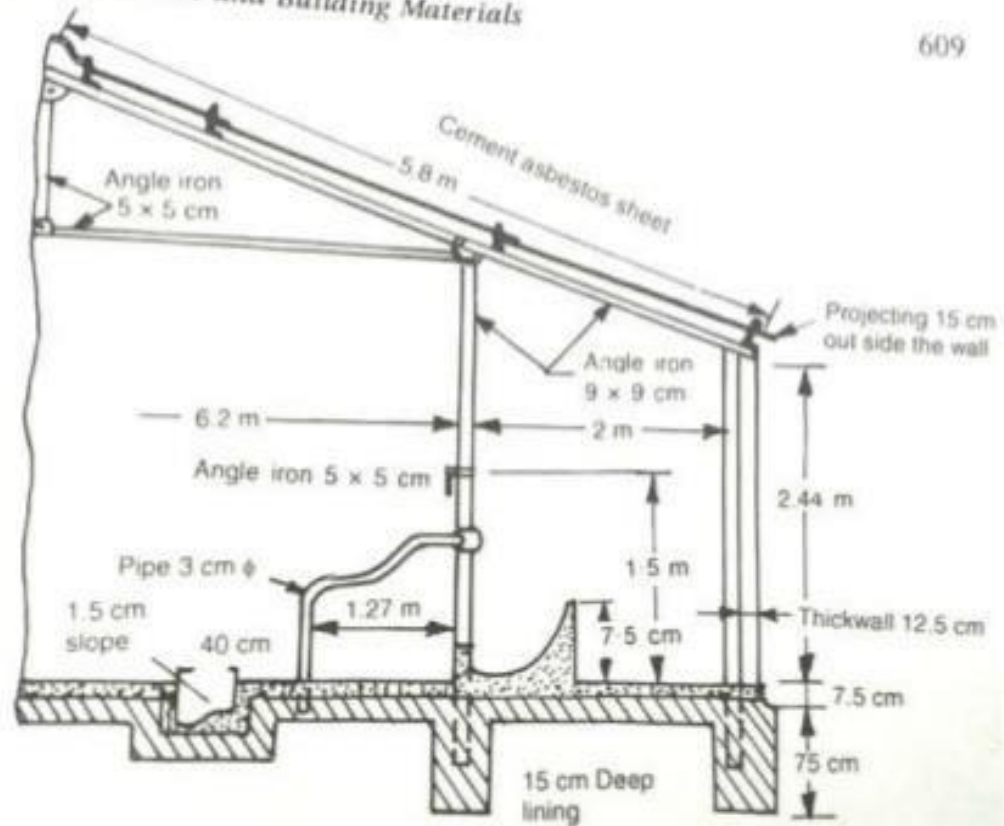


**Centurion**  
**UNIVERSITY**

Shaping Lives...  
Empowering Communities.

*Animal Shelters and Building Materials*

609



*Courtesy : Gas-Coigne & Co.*

*Fig. 12.2. Dairy barn-Face out type (half section)*



**Centurion**  
**UNIVERSITY**

*Shaping Lives  
Empowering C*

## **Loose housing barn:**

- ✚ It permits the animals to move about freely and allows simple and economical construction of the feeding and shelter places.
- ✚ The area required per cow depends upon the climate, whether an inside or outside feeding arrangement is used, size of the cows and average production of the herd.
- ✚ A high producing cow needs more feed, more water and also more space.
- ✚ The floor space both for loafing as well as for feeding may be required in the order of 9 to 11 sq. m per cow.
- ✚ The feed manger space may be between 70 and 75 cm wide for each cow.



Centurion  
UNIVERSITY

Shaping Lives...  
Empowering Communities

## Milking Parlour:

The milking parlour or milking room is a room where the cows are milked, but not housed. It is an essential part of the loose housing barn but may also be used with a stanchion or stall barn.

The most convenient milking room now in common use is known as the **tandem** with either single or two string stall arrangement.

The herringbone milking parlour is also widely used.

## Open air barn:

It does not have any cover. The cows live in fields and they are fed and milked there. This system is also known as the loafing barn system and is not common on a well established dairy.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

**Feeding shed** This is a covered shed to protect the feed from rain and an area of 3.7 sqm (40 sqft) is recorded for each cow. Pavement with mangers is better for keeping the feeding area clean. The space of manger for each cow varies from 67.5 cm to 75 cm. and the depth should be sufficient to prevent wastage by dragging out of the mangers. Water tub of 300 litres capacity are provided for every 15 cows in the feeding room. For feeding shed a lean to roof shed with no enclosure on one side is economical and suitable.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

**Bedding area:** This is also a covered area with an ample space of 6.4 sqm per cow. The shed room should be a min. of 3m to allow piling up of manure for 0.9m height. The bedding area should include separate place for caves at the rate of 2.8 sqm (30 sqft) per cow.

**Exercising yard:** This is an open enclosed space to afford free movement of animals to get fresh air and exercise. The space required for each cow is 9.2 sqm (100 sqft). This is provided adjoining the bedding area. The yard should have a slope of 1 in 6 for the first 1.0m width and then 2% slope away from the bedding area for draining water.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

**Milking rooms :** The milking room is provided separately where facilities are made for milking a few cows at a time. This is constructed adjoining the feed room so that other animals can be kept there awaiting their turn to be led to milking. For providing facility for milking, stalls should be constructed to keep the animals at the floor level or raise above the floor where the operator works. The level floor stall arrangements are similar to stall barns with space for litter and feeder alleys. The room is covered on the sides and top to keep it clean.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

**Stall systems** are either floor level, with the platforms at the same level as the floor on which the operator works or elevated with the cow platform from 30" to 36" above the operators (fig) floor level stalls are usually arranged abreast like the stalls in a stall barn.

The cows may walk through after milking or back at F or one operator the most convenient number of stalls in this arrangement see was to be 6 to 1, for two operators, 8 to 12 or 16 stalls should be provided.

**The elevated stall system** places the cows at a more convenient and comfortable work height for the operator. If milk is carried from milking room to milk house, the operators floor should be at the same level as the milk house floor. The stalls are elevated and suitable ramps provided for the cows.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

**Chute:** There are a no of arrangements of stalls suited to the elevated stall system. the chute type stalls are probably the least expensive to construct, because no wall for each cows is necessary and fewer gates need be provided for handing the cows. However all the cows, in one line must be let in and released at one time. A slow milker may hold up the line and cause lost time. Feed boxes that slide out into 1 operators ara permit clean. Passage for the cows to move thro. The chute arrangement can be built force single row or two rows of cows. Feed in tube is filled with feed with the help of chute pipe from an elevated feed storage hub.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

**Tandem type:** The tandem type of arrangement permit cows to enter and be released individually. However a wale for the cows must be provided along the side. Gate must be provided on each stall, one for entrance and one for exit. The tandem arrangement man be built for one or two cows of cows.

**U Type:** or square type of arrangements are modifications of the tandem arrangement. In both the cows can be brought in and released individually. These arrangements may centralize the milking operation more than other types.

Montana: It is an abreast arrangement with elevated stall. For one operator, one working area and two stalls are provided for two operators, two working areas and four stalls are provided.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

### **Pen barn:**

- ✚ Pen barns are structures for sheltering and restricting dairy animals.
- ✚ On all dairy farms there should be additional accommodation for calving, calf rearing and housing sick animals.
- ✚ Pen barns or isolation boxes are suitable for this purpose.
- ✚ They are either away from the main barn or they form a part of it.
- ✚ Sometimes a separate pen is provided for each bull.
- ✚ The size of the pen varies from 11 to 17 sq. m for different needs.
- ✚ Either a square pen or a rectangular one having a minimum width 3 m should be used.



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

# SPACE REQUIREMENTS OF DAIRY ANIMALS AND LAYOUTS OF DAIRY FARMS

All animals require shelter for protection and comfort. They can perform better under favourable environmental conditions. Housing of animals need initial capital to the extent the dairy farmers can afford. The animals are to be protected from high and low temperature, strong sunlight, heavy rainfall, high humidity, frost, snowfall, strong winds, ecto-parasite and endo-parasites. The comfortable temperature range for dairy breeds of cattle, buffaloes and goats is 15°C to 27°C. Climatic stress occurs when the temperature goes 5°C below or above this range.

High humidity combined with high temperature causes more stress to animals in tropics. Rainfall in cold climate also causes stress in temperate zone. Strong winds further aggravate the conditions both in tropics and temperate climate. Several techniques are available to provide relief from hot weather conditions for lactating dairy cows. In tropical and sub-tropical climates, well-ventilated shed is a necessity at points of high heat stress, such as feed barns, loafing areas, and in holding areas. It is important to provide a sufficient flow of air through the building in which the animals are kept to ensure optimum thermal conditions for dairy animals.



## Floor, feeding manger and watering space requirements of dairy animals

SR. NO	TYPE OF ANIMAL	FLOOR SPACE) PER ANIMAL (M <sup>2</sup> )		FEEDING (MANGER) SPACE PER ANIMAL (CM)	WATER TROUGH SPACE/ ANIMAL (CM)	MODE OF HOUSING
		COVERED AREA	OPEN AREA			
1	Young calves (< 8 weeks)	1.0	2.0	40- 50	10-15	Individual or in groups of below 5
2	Older calves (> 8 wks)	2.0	4.0	40-50	10-15	Groups of below 15
3	Heifers	2.0	4.0-5.0	45-60	30-45	Groups of below 25
4	Adult cows	3.5	7.0	60-75	45-60	Groups of below 25
5	Adult Buffaloes	4.0	8.0	60-75	60-75	Groups of below 25-30
6	Down calvers	12.0	20-25	60-75	60-75	Individual
7	Bulls	12.0	120.0	60-75	60-75	Individual
8	Bullocks	3.5	7.0	60-75	60-75	Pairs



**Centurion**  
**UNIVERSITY**

*Shaping Lives...  
Empowering Communities...*

## **MODEL LAYOUTS FOR THE CONSTRUCTION OF VARIOUS FARM BUILDINGS**

Model layouts for the construction of various farm buildings have been prepared under loose system of housing. The loose system of housing dairy animals has been recommended for most of the agro-climatic zones of the country with minor modifications except in heavy rainfall regions and the high altitude regions where winters are very harsh. The dairy animals under loose system of housing are grouped together based on their age in case of growing animals and based on their physiological condition when they are adults. The various categories of dairy animals may be formed such as milking cows, dry and pregnant cows, down-calvers, bulls, heifers and the calves. All these animals need to be housed in separate sheds and the provision in the layout has to be made accordingly.



**Centurion**  
**UNIVERSITY**

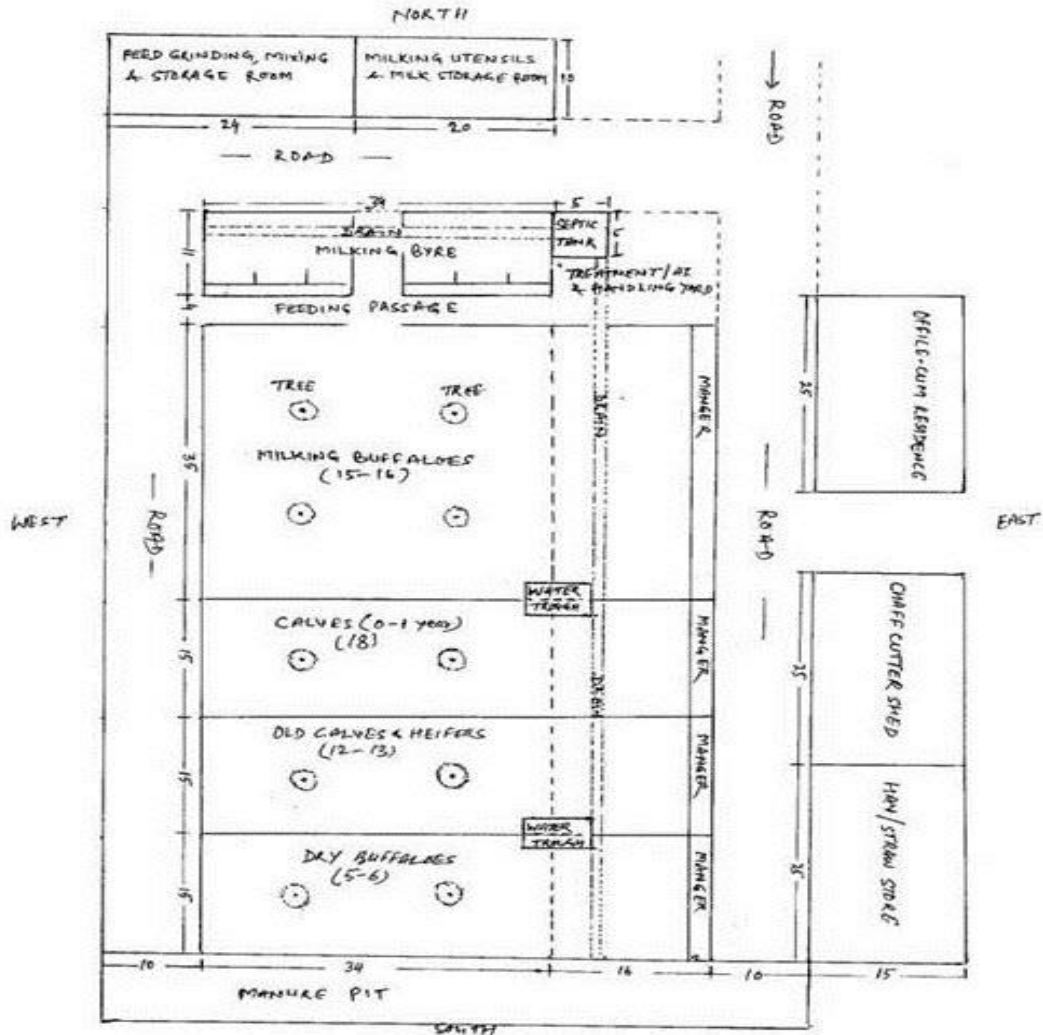
*Shaping Lives...  
Empowering Communities...*

Apart from the animal sheds the certain other ancillary buildings/structures are also required to be constructed such as chaff cutter shed, feed store, implements store, straw store, milking parlour, milk room, silo pits and manure pits apart from the office, lawns. The large sized dairy farms may also need overhead water storage tank, a small sized workshop and parking space. The farm building may be arranged in such a manner that they result in higher animal productivity and labour efficiency with minimum movement of people and the animals. For example, the milking parlour may be situated close to the milking cows shed; the milk room may be adjacent to the milking parlour, the feed storage room also should be close to the milking parlour as the compound feed is mostly fed in the milking parlour during milking. The calf shed should be close to the milking cows shed if weaning of calves is practiced. The farm building should be constructed using cheaper locally available construction materials so that the construction cost is minimized.



**Centurion UNIVERSITY**  
 Shaping Lives...  
 Empowering Communities...

LAYOUT OF BUILDINGS FOR A 20 BUFFALOES BASED DAIRY UNIT



**Layout of Dairy Farm for 50 Cow/ Buffalo Unit**

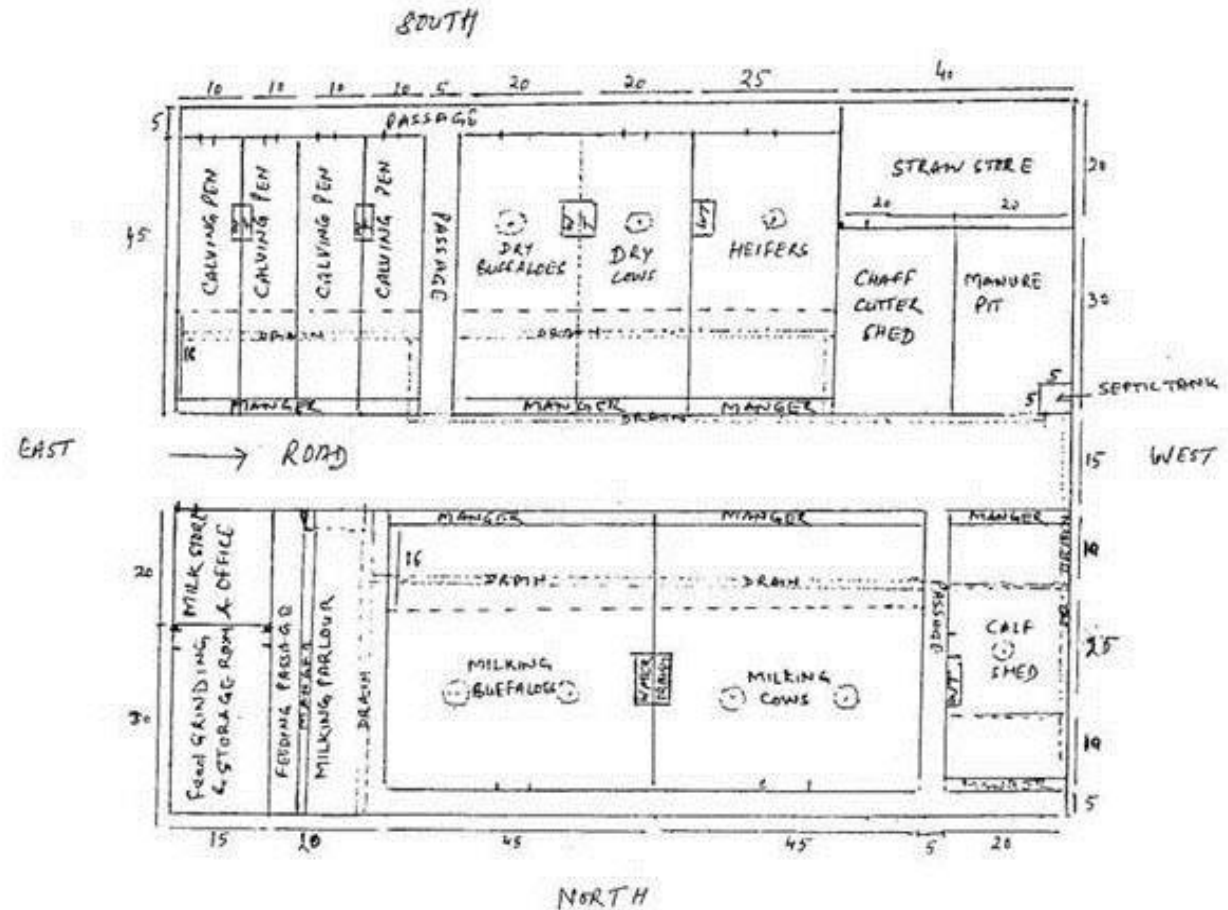
As prepared by Dr. M.L. Kamboj (NDRI, Karnal)



**Centurion  
UNIVERSITY**

Shaping Lives...  
Empowering Communities...

## LAYOUT OF BUILDINGS FOR A 50 DAIRY ANIMALS (25 COWS & 25 BUFFALOES) UNIT



\* All dimensions in feet.  
☉ Tree, WT - water trough

### Layout of Dairy Farm for 200 Cow/ Buffalo Unit

*As prepared by Dr. M.L. Kamboj (NDRI, Karnal)*