

# Barn Design for Robotic Milking



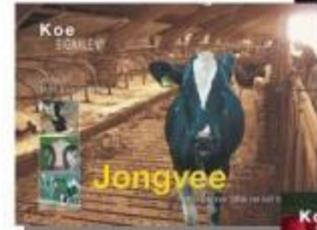
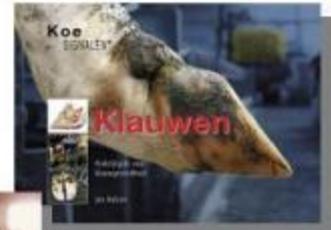
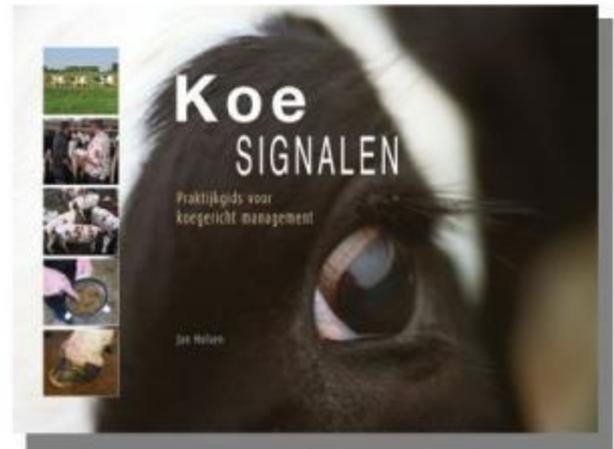
Jack Rodenburg

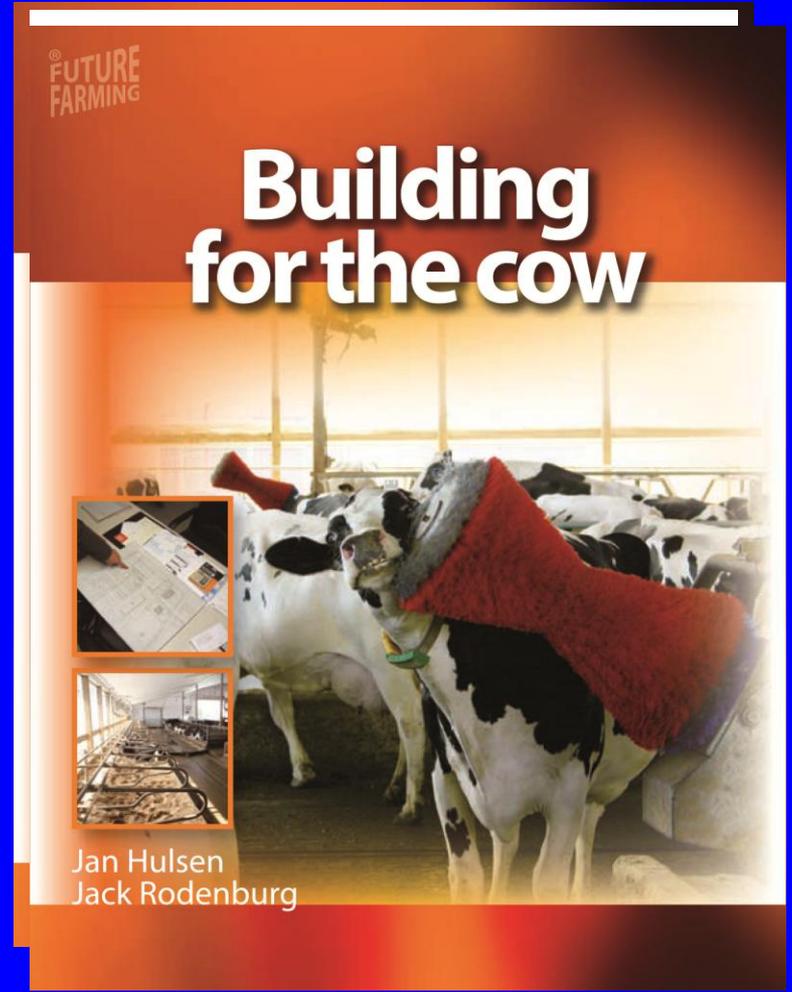
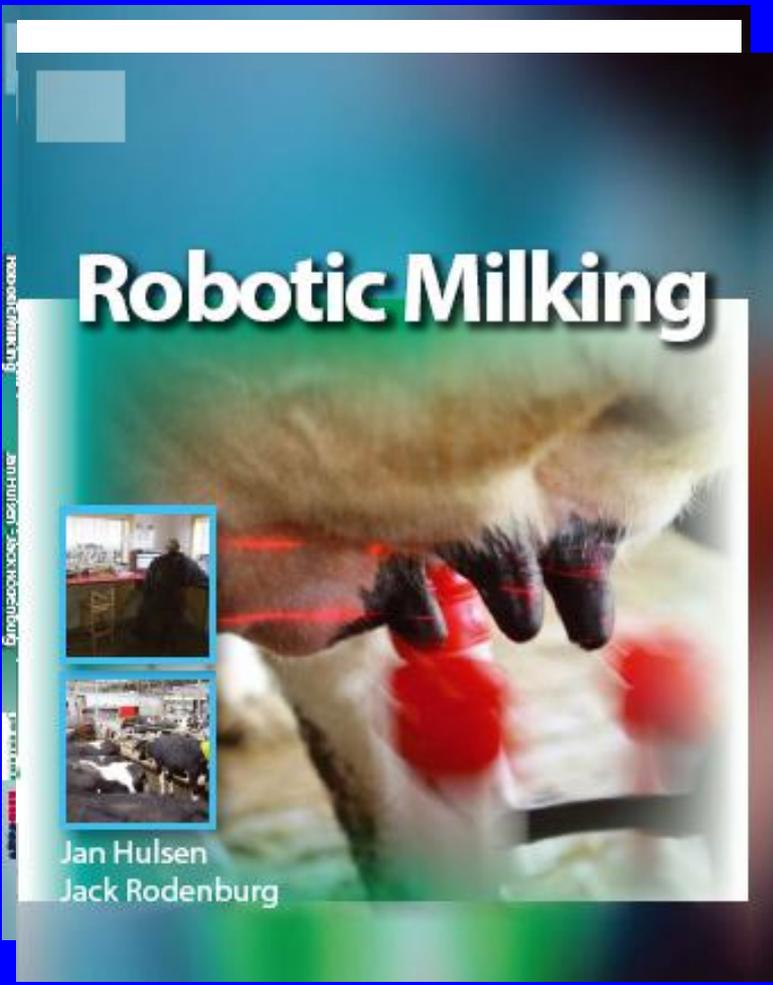
("Retired" after 34 years as dairy systems specialist with OMAFRA)





I have learned a lot about cow behaviour working with this team in Holland



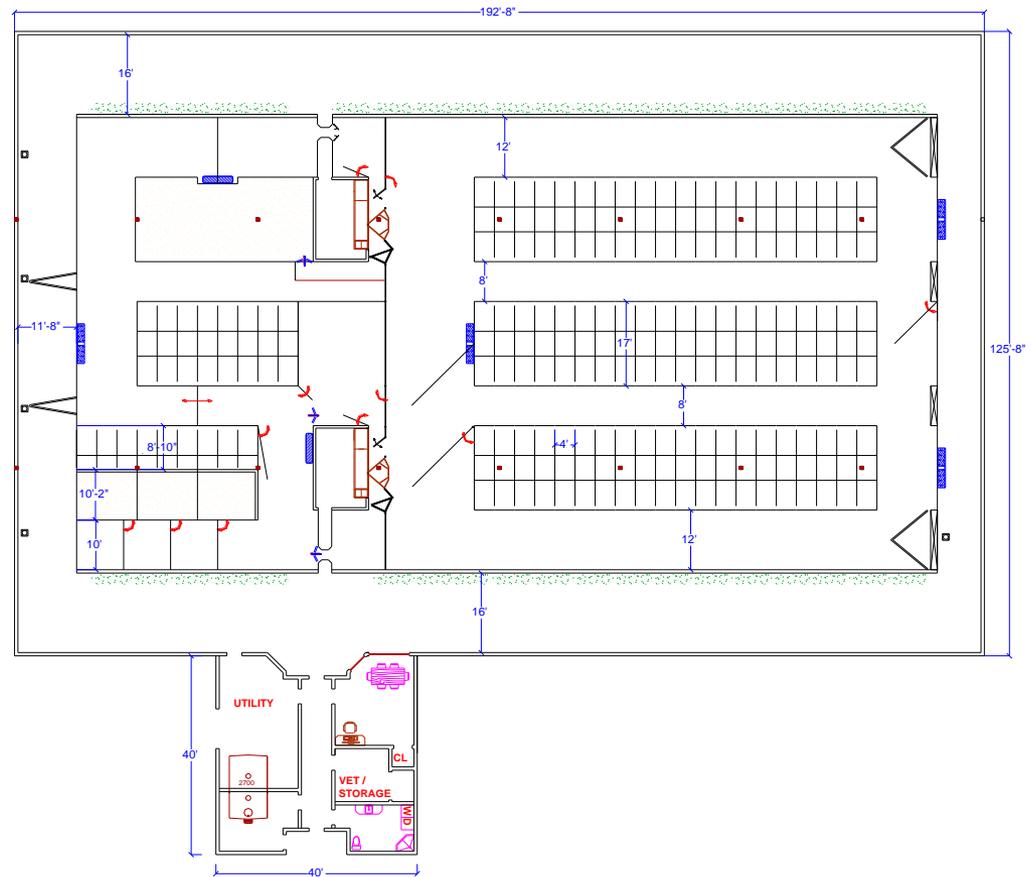


Vetvice books I have  
co-authored



Working in Finland,  
Sweden, and Denmark  
with Cowhomes, Jouni  
Pitkaranta

Our long term objective is to design the perfect robotic milking barn.



*DairyLogix* / **VETVICE** / *Cowhomes*

**Robotic Milking Barn**

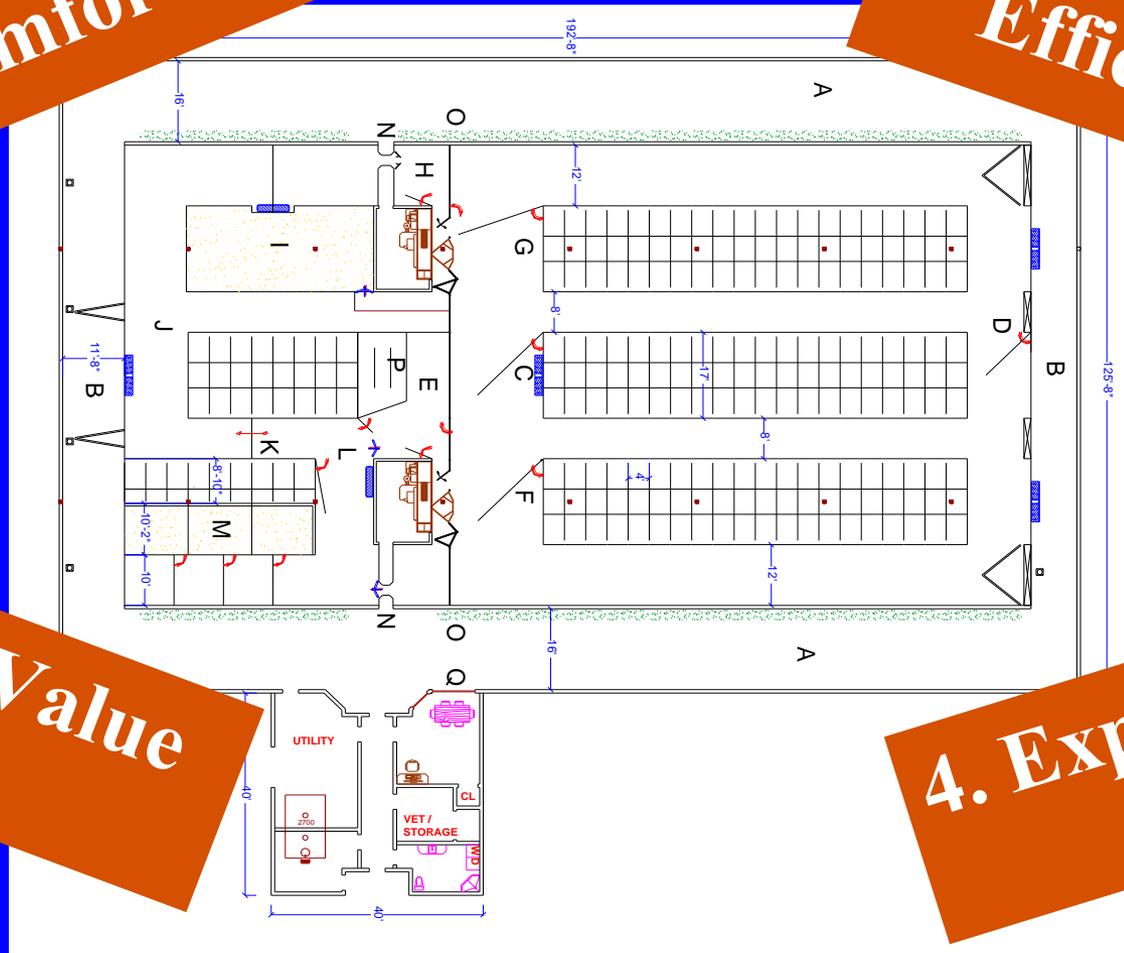
# The Corner Stones of Dairy Housing Design

1. Cow Comfort

2. Labour Efficiency

3. Cost / Value

4. Expandable

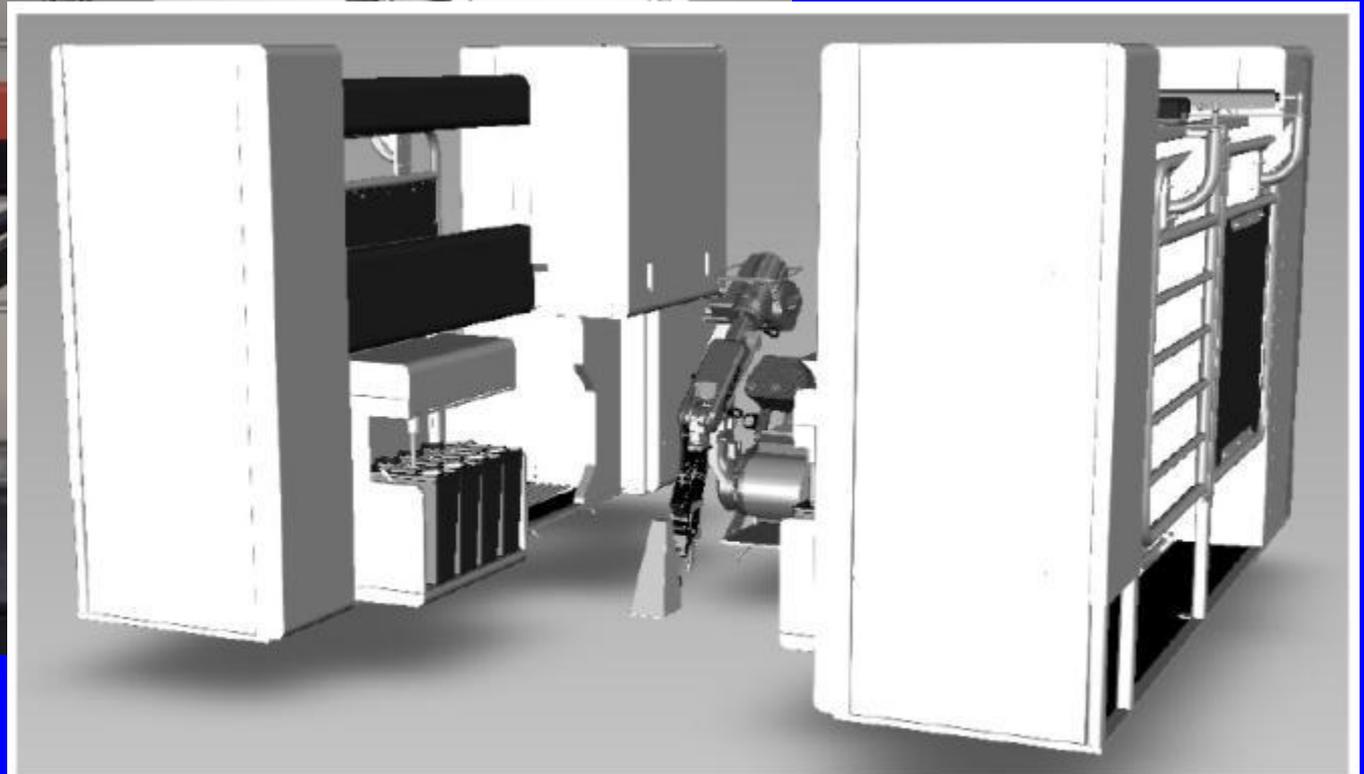




Both of the current market leaders achieve excellent results where good technical support is provided



# Insentec offers an industrial robot arm placed between two milking stalls



Robotic Milking System in mirror set-up

Boumatic : self contained, milks between the rear legs, exit both sides of the box



Easy route with no turns for separation and milking special needs cows.

Different robots require different layouts but the same principles apply. This tollgate system has merit for Insentec and Boumatic double box applications



# GEA Multibox with up to 5 stalls in tandem



To sort cows exiting from tandem stalls you must use a commitment pen.

Roboleo tie stall robotic milker - future welfare demands will make this difficult, especially with pasture



# What will robotic milking look like in the future?

This is a Dutch research project taking the robot into the pasture



**Perimeter feeding**

**120 Comfortable Freestalls for Milking Cows**

**Perimeter feeding**

**Fetch pen 1**

**Fetch pen 2**

**Robot 1**

**Robot 2**

**Chute (s)**

**Office**

**Tank**

**Utility**

**Management rail**

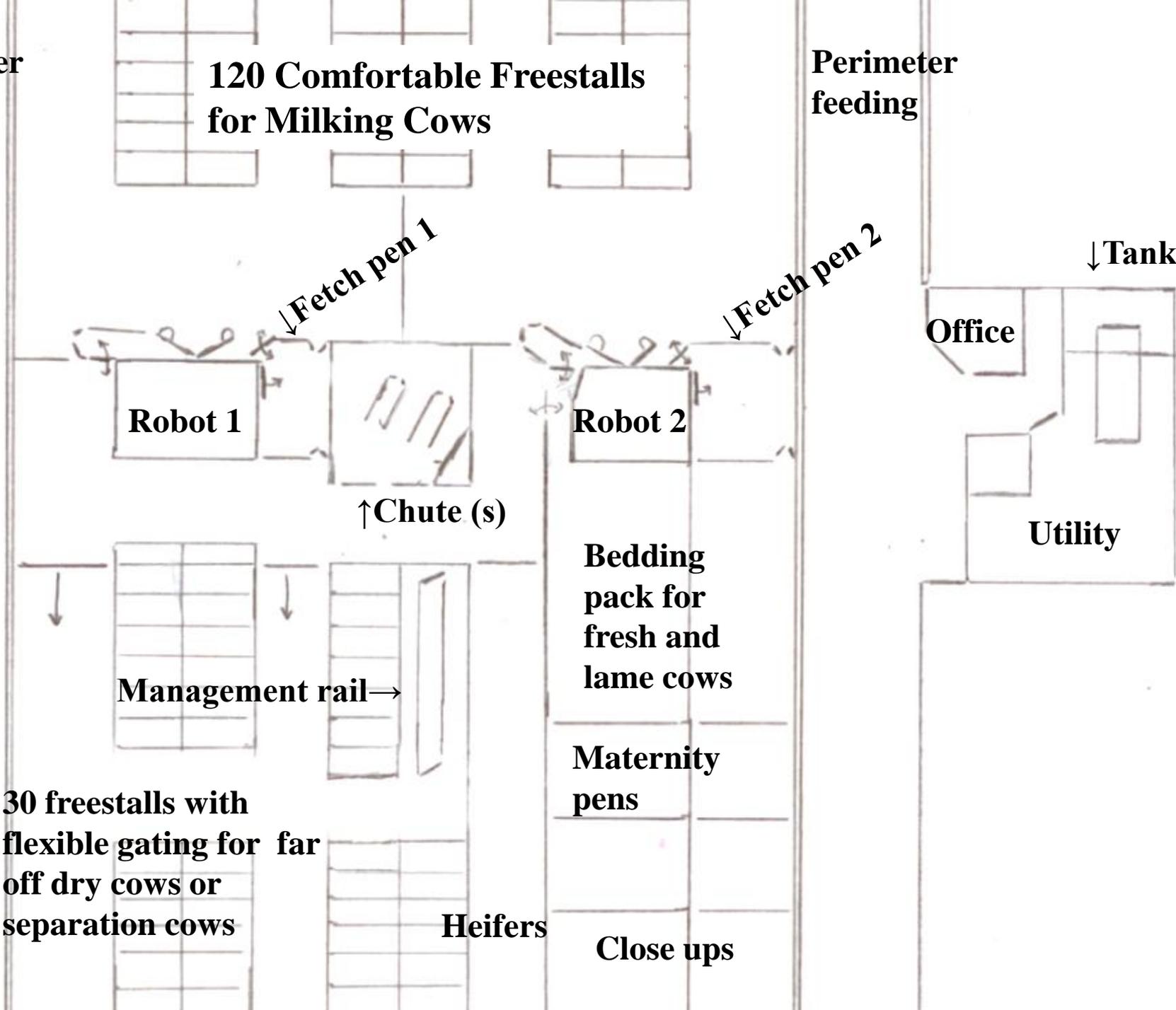
**Bedding pack for fresh and lame cows**

**30 freestalls with flexible gating for far off dry cows or separation cows**

**Maternity pens**

**Heifers**

**Close ups**

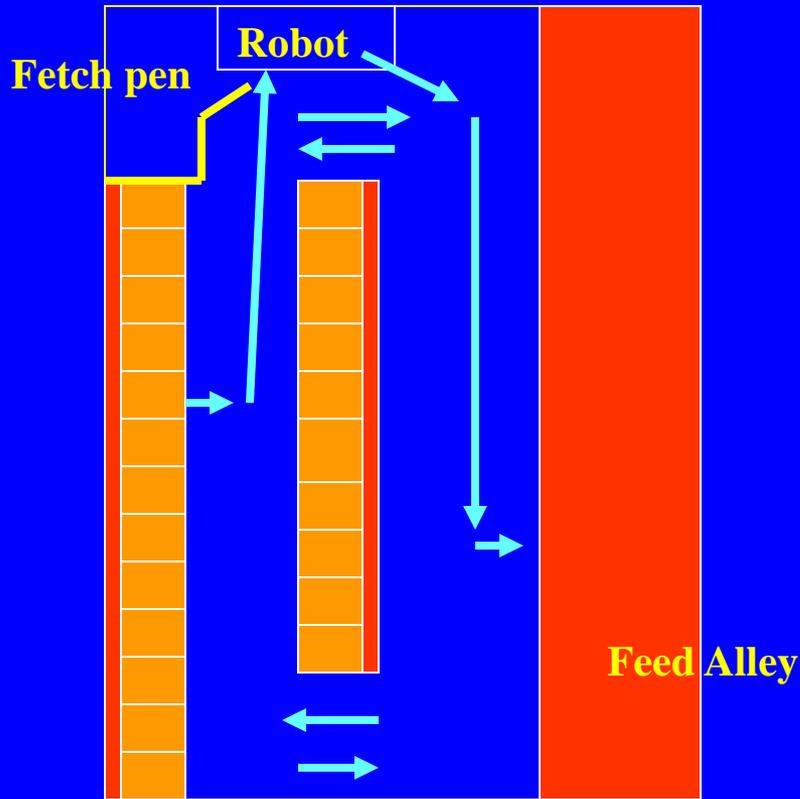




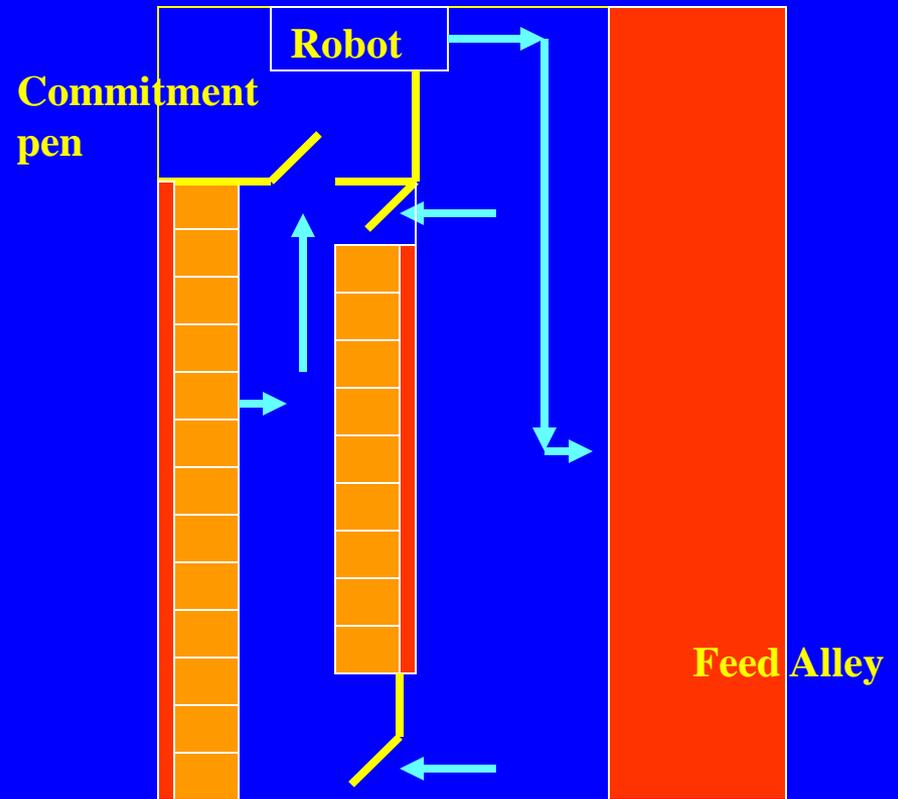
Cow comfort in a robot barn  
= free traffic

# Free or Forced Cow Traffic ???

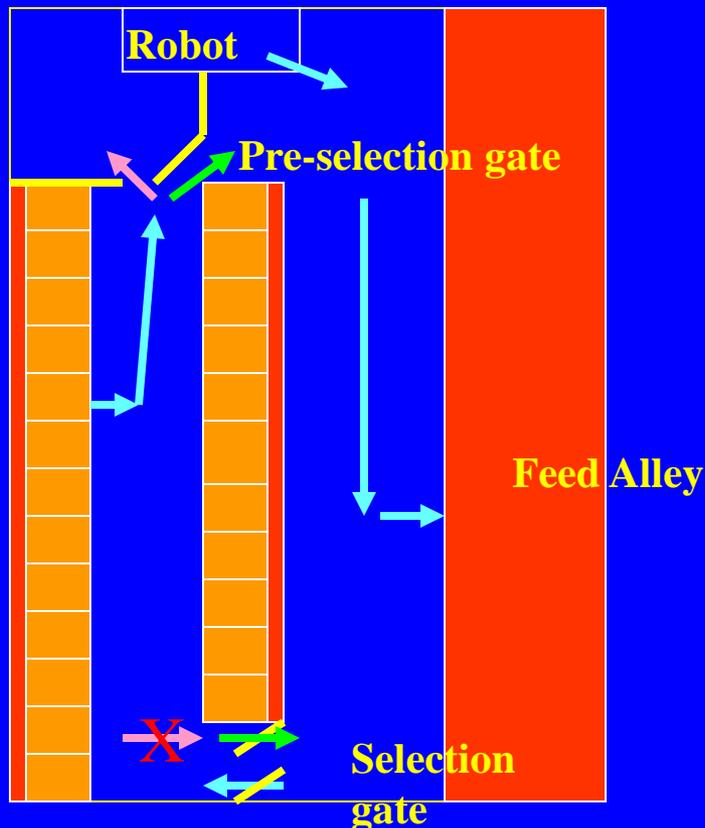
Free Cow Traffic: Cows can access all areas



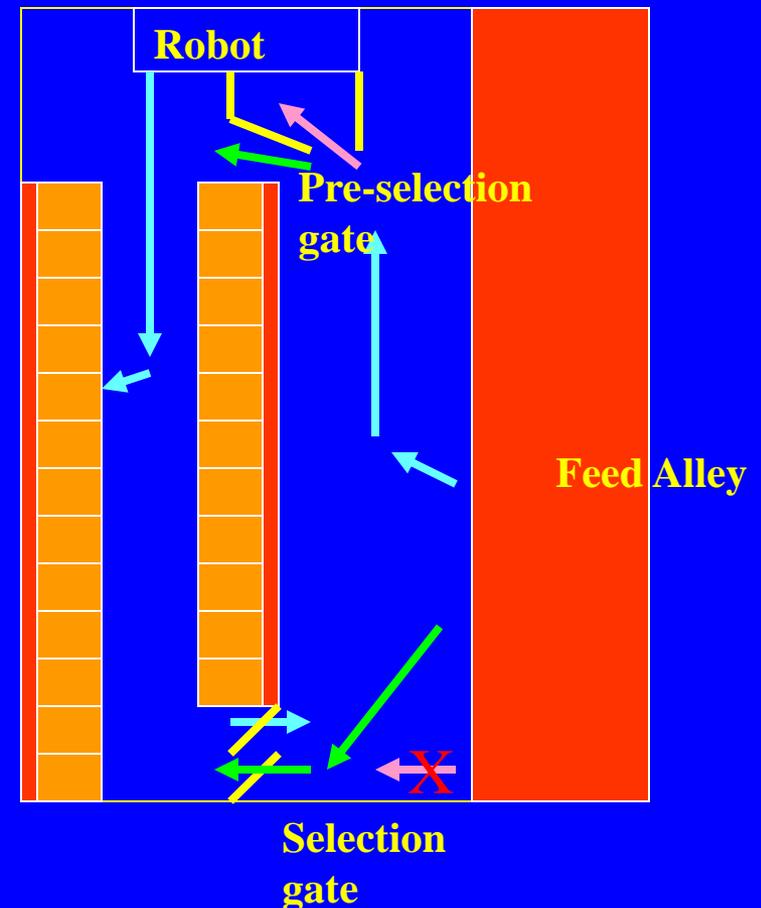
Forced Cow Traffic: Cows can only access feed after passing through the robot



**Forced Cow Traffic (with Pre-selection):** Eligible cows directed to robot and others to bunk



**Feed First Forced Traffic:** Free bunk access, Eligible cows directed to robot and others to freestalls





Improve on this with multiple selection gates and more open access to them, and exit cows directly to the other side of the barn





*Korna får kraftfoder i First Feed-automater från DeLaval. Gången till roboten är som en labyrnt för att ingen ko ska kunna blockera trafiken.*

Every cow waits the same amount, but in a very stressful place

# Free vs Forced cow traffic (Thune 2002)

	<u>free</u>	<u>forced</u>	<u>pre-selection</u>
no. milkings	2.0	2.6	2.4
no. of meals	12.1	3.9	6.5
average time			
waiting at robot (minutes/day)			
Dominant Cows	78	140	124
Timid Cows	95	240	168

# Free vs. Forced Cow Traffic

Bach et. al. 2009

/cow/day	Free traffic	Forced Traffic	P-value
Milkings	2.2	2.5	<0.001
Fetches milkings	0.5	0.1	<0.001
Bunk Ration intake	41.0 lbs	38.8 lbs	0.24
No. of bunk visits	10.1	6.6	<0.001
Milk production	65.7 lbs	68.1 lbs	0.32
Fat %	3.65	3.44	0.06
Protein %	3.38	3.31	0.05
Fat yield	2.40 lbs	2.34 lbs	
Protein yield	2.22 lbs	2.25 lbs	

# Forced vs Free Traffic

- With free traffic a new fetch cow is a signal to check for a new case of clinical mastitis or lameness. The new fetch cow costs time but provides management information
- Forced traffic decreases the emphasis on feeding in the robot and reduces the number of fetch cows. When there are strong economic incentives to minimize use of pelleted feed in the robot and replace it with home grown grain in the TMR, there may be justification for considering forced traffic

# Free or Forced Cow Traffic

- Both can work very well with good management
- But when things go a little wrong:
  - forced traffic COWS suffer fewer meals and longer waiting times (and foot health issues)
  - Free traffic FARMERS suffer increased fetching. ( a warning to step up management)
  - I design for both but have a strong preference for free traffic!

# “Freedom to Choose”



For you . . . . But not for the cow . . . There are many examples of excellent results with blue robots with free cow traffic!

A typical feed first barn:  
4 row of stalls, smart gates, and  
 $\pm 30$  cm manger space per cow





Does forced traffic justify less manger space ??  
Not with feed first.....and not with high milking frequency !!

# Mason Dixon Farms, Gettysburg, Pennsylvania

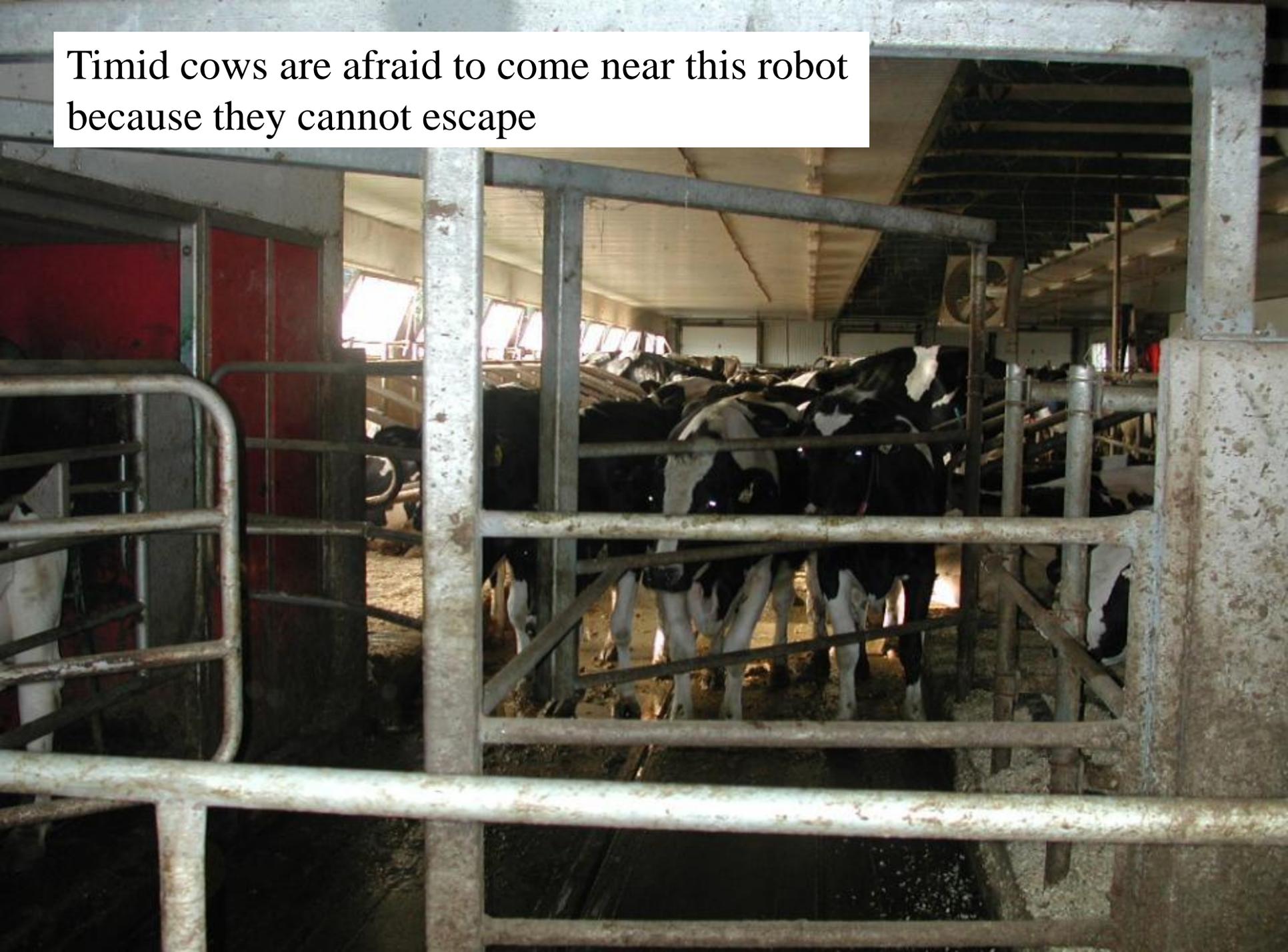


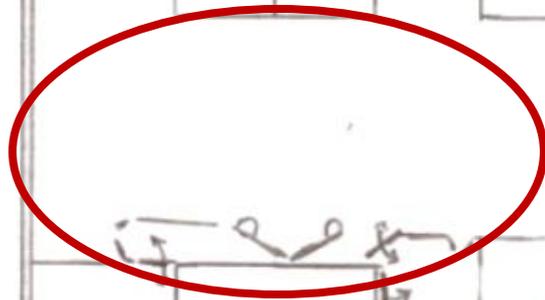
- 20 robots, two 170 x 400 ft 4 plus 4 rows, rest first forced traffic and perimeter feeding
- room for 2 more barns sloping 2% to the center
- They are highly respected innovators and they chose forced traffic

# The Key to Making Free Traffic Work is.....

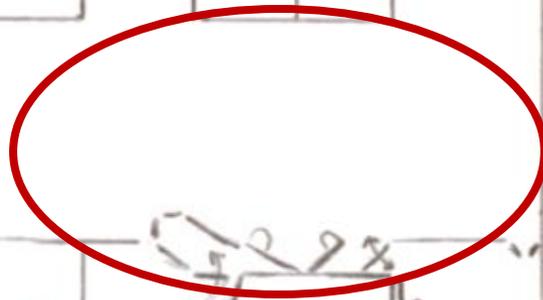
Space in front of the robots

Timid cows are afraid to come near this robot because they cannot escape





**Robot 1**



**Robot 2**

Large open area in front of the milking stalls

- 20 feet from the milking box to the first freestall (also adds more manger and headlock space)
- Locate cow brushes, pasture selection gates, and computer feeders far away from this area to spread out barn activity



What is the problem?  
How will you solve it?



This is better !!

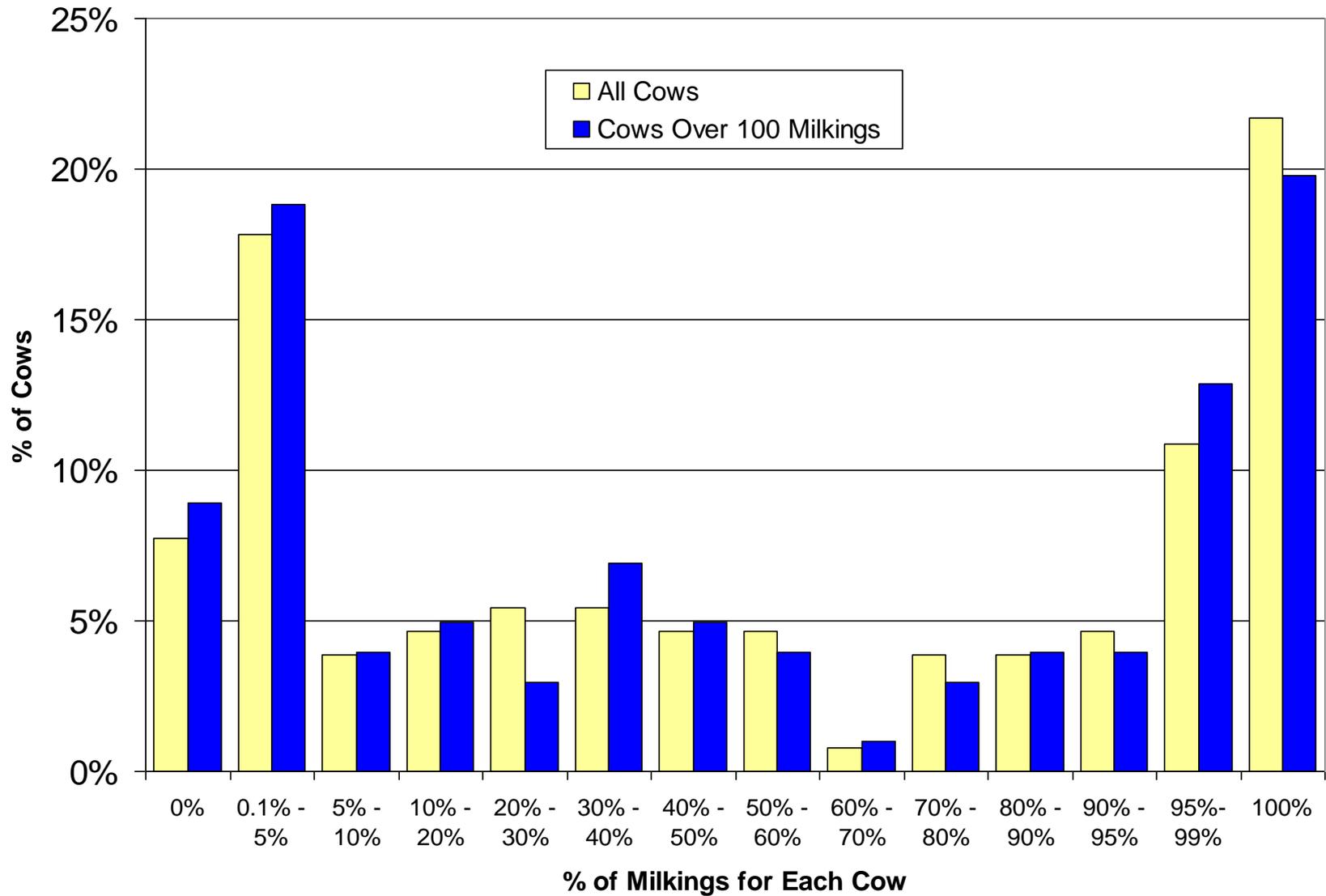


Does robot orientation matter?

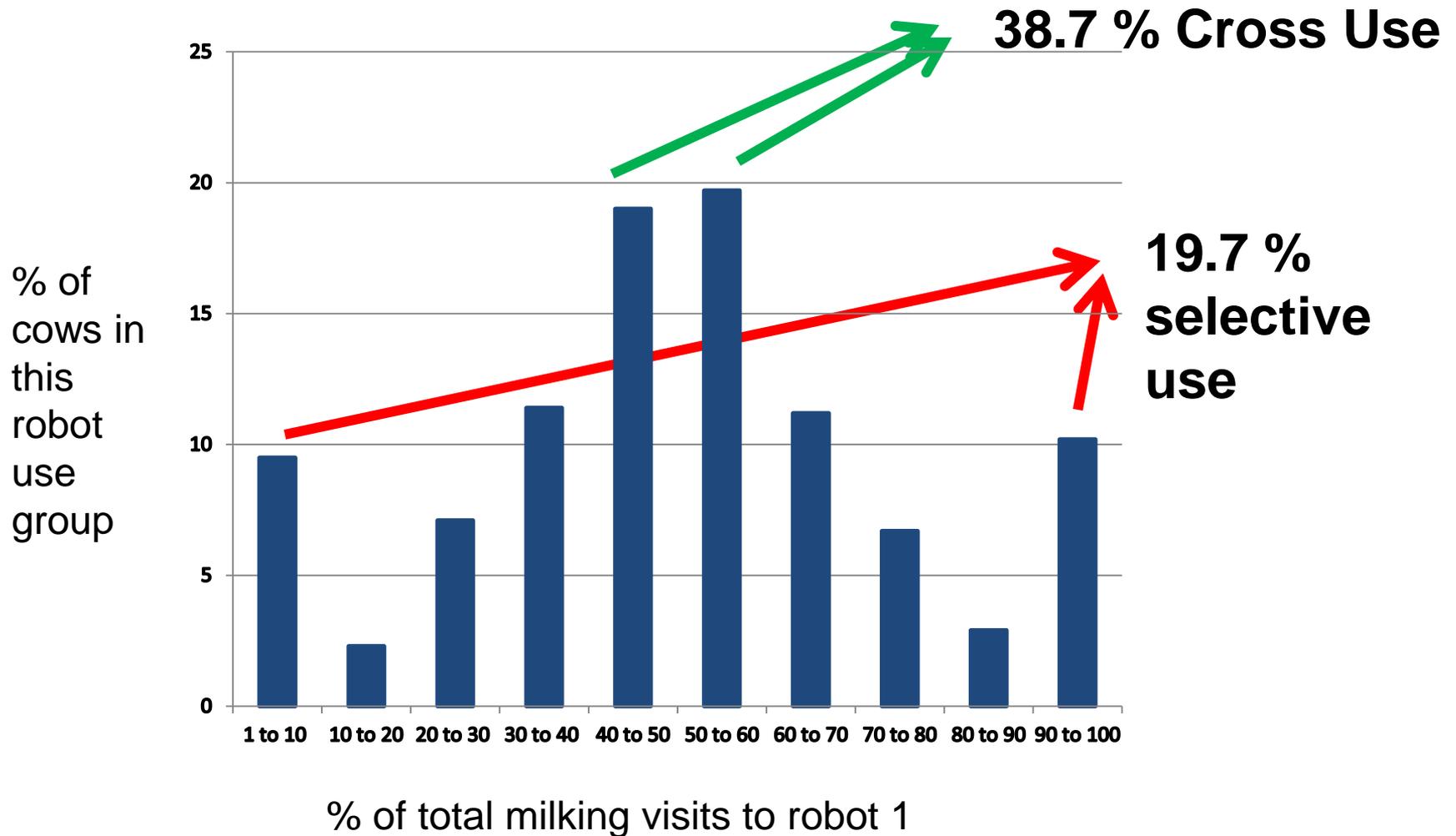


# Cows Choosing to be Milked in Stall 101 vs 102

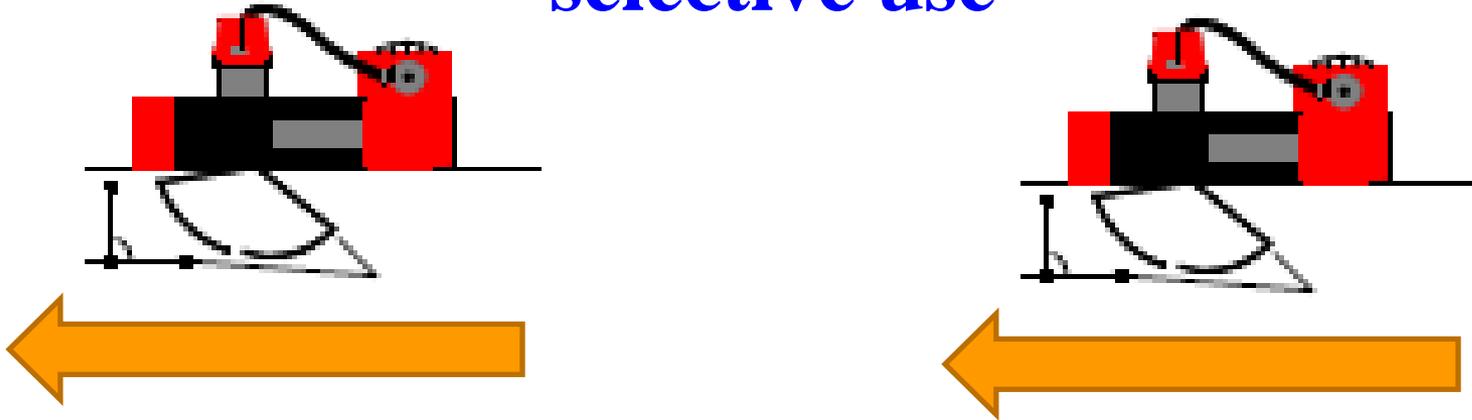
(average 52.9%)



# 3 months of data from 12 herds 1165 cows



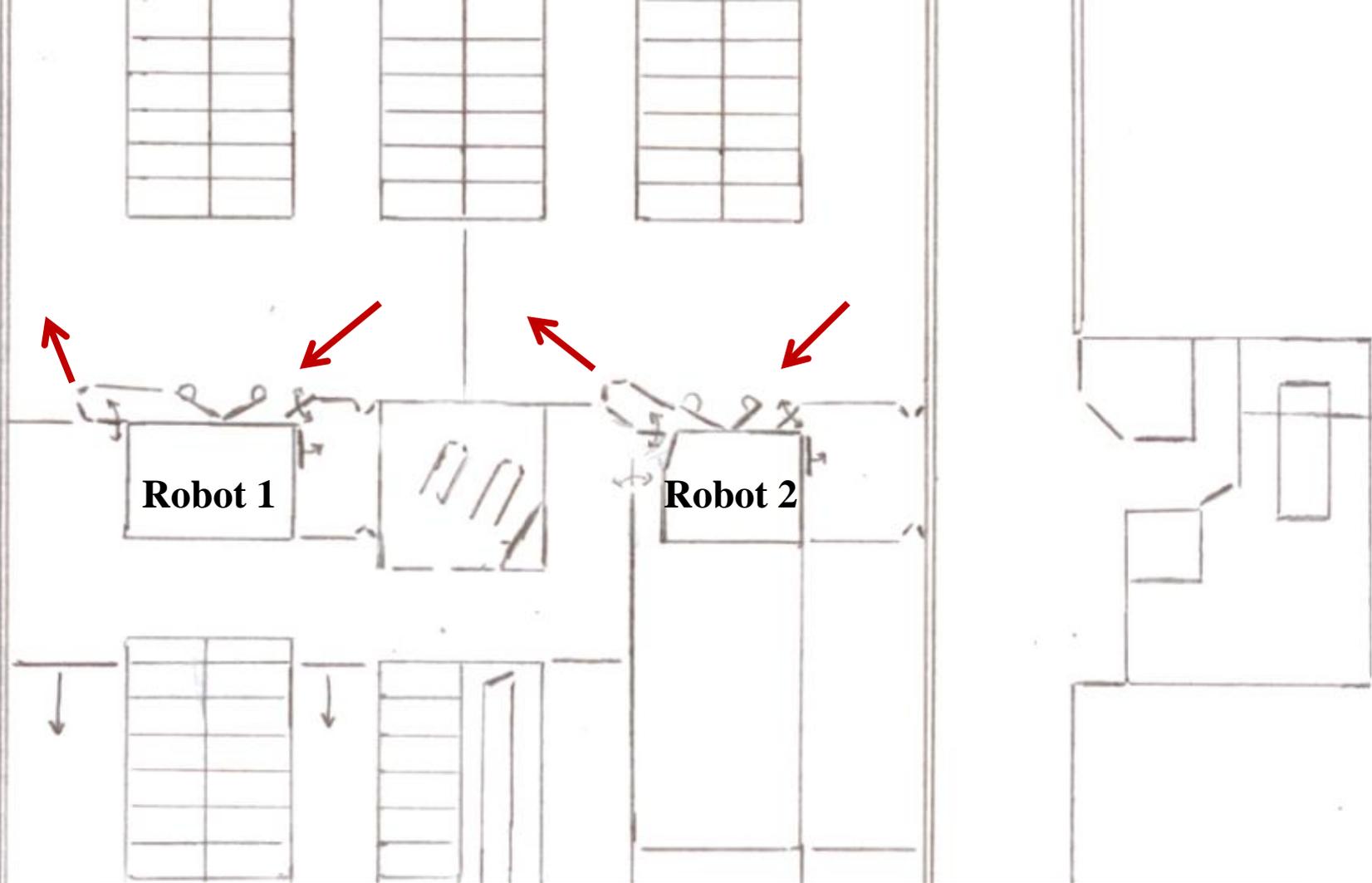
# Robots facing the same way result in the least selective use



Cows turn the same way to enter  
Good visibility from the resting area

Cross use was high at 48.6 %  
(vs 38.7% in all herds)

Selective use was lowest at 8.1 %  
(vs 19.7 % in all herds)



All robots face the same way



With one robot per room you can hear vacuum and air leaks, worn bearings etc.

In large herds, one room saves cost and service labour.....but it is not my preference

# Cow Comfort in the Milking Stall



Ceiling Fans for ventilation and fly control

Level entry

Rubber floor

Highly visible from the barn

# Cow Comfort in the Milking Stall



- Lely model A2 – small space and butt plate to locate udder
- A3 – bigger space and load cells to locate udder
- A4 – straight in and out and tail head camera

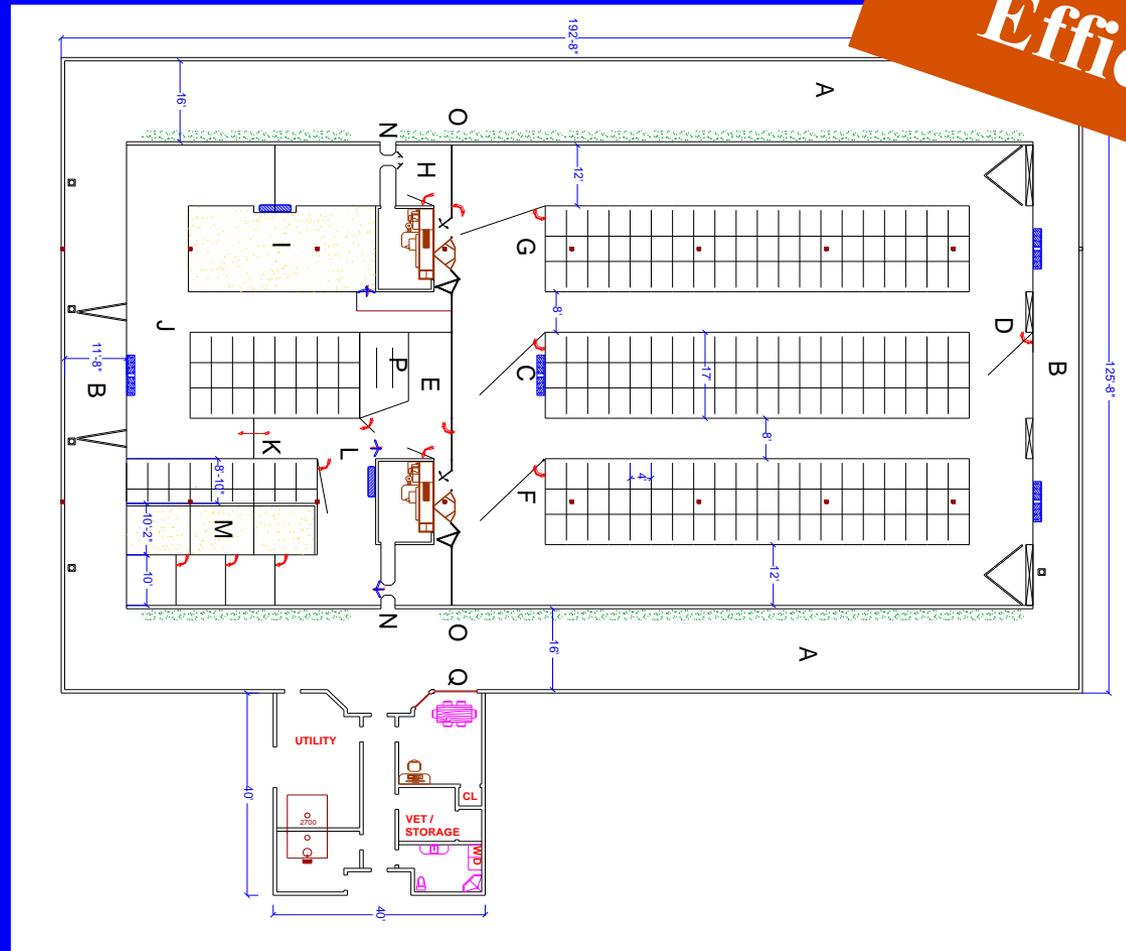
Better comfort in the stall has increased visits and reduced fetching in newer models



If the system has a butt plate and adjustable feed bowl, adjust these properly.

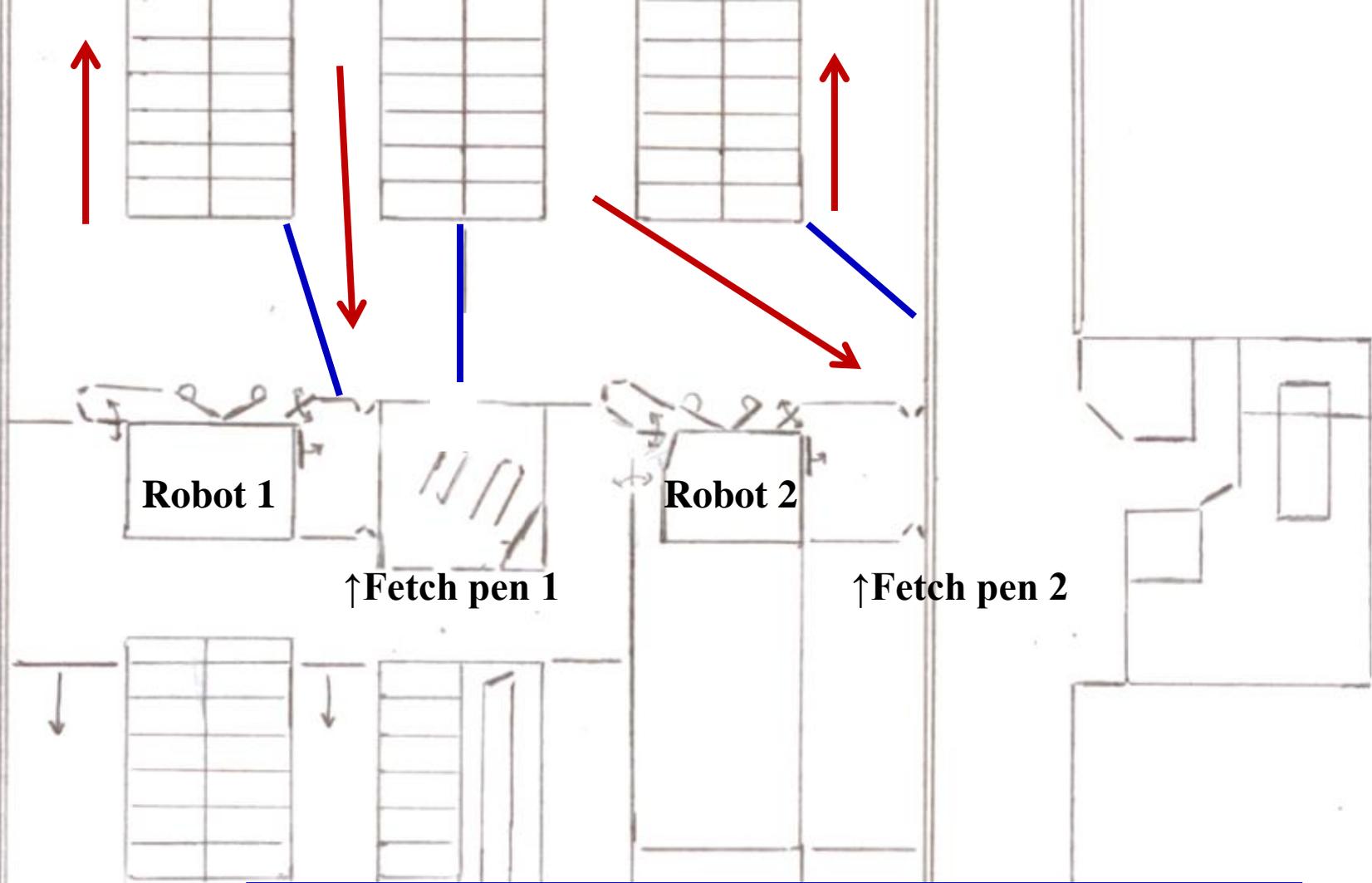
# The Corner Stones of Dairy Housing Design

## 2. Labour Efficiency



# New labor demands with robotics

- Fetching cows that don't attend voluntarily
  - 2 to 10% need fetching on well run dairies
  - Up to 25% need fetching in older research
- Provide simple cow routing and low stress fetch pens to get these cows milked
- Manage the herd and design housing systems to minimize the number of cows that require fetching

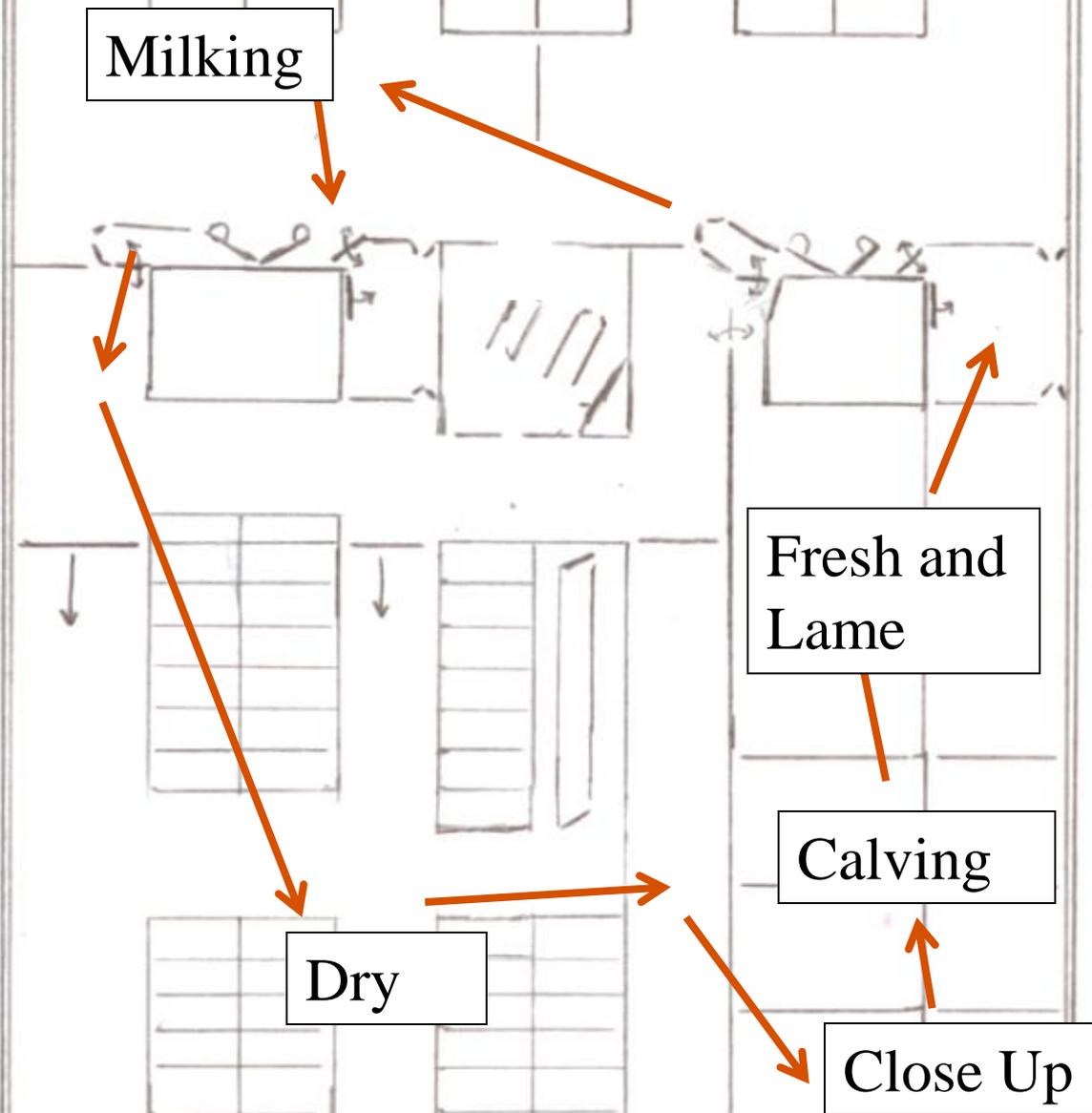


Simple routing that makes all handling a one man job  
a. for fetching





## b. Simple routing from group to group



## c. Simple routing to the handling area

Milking

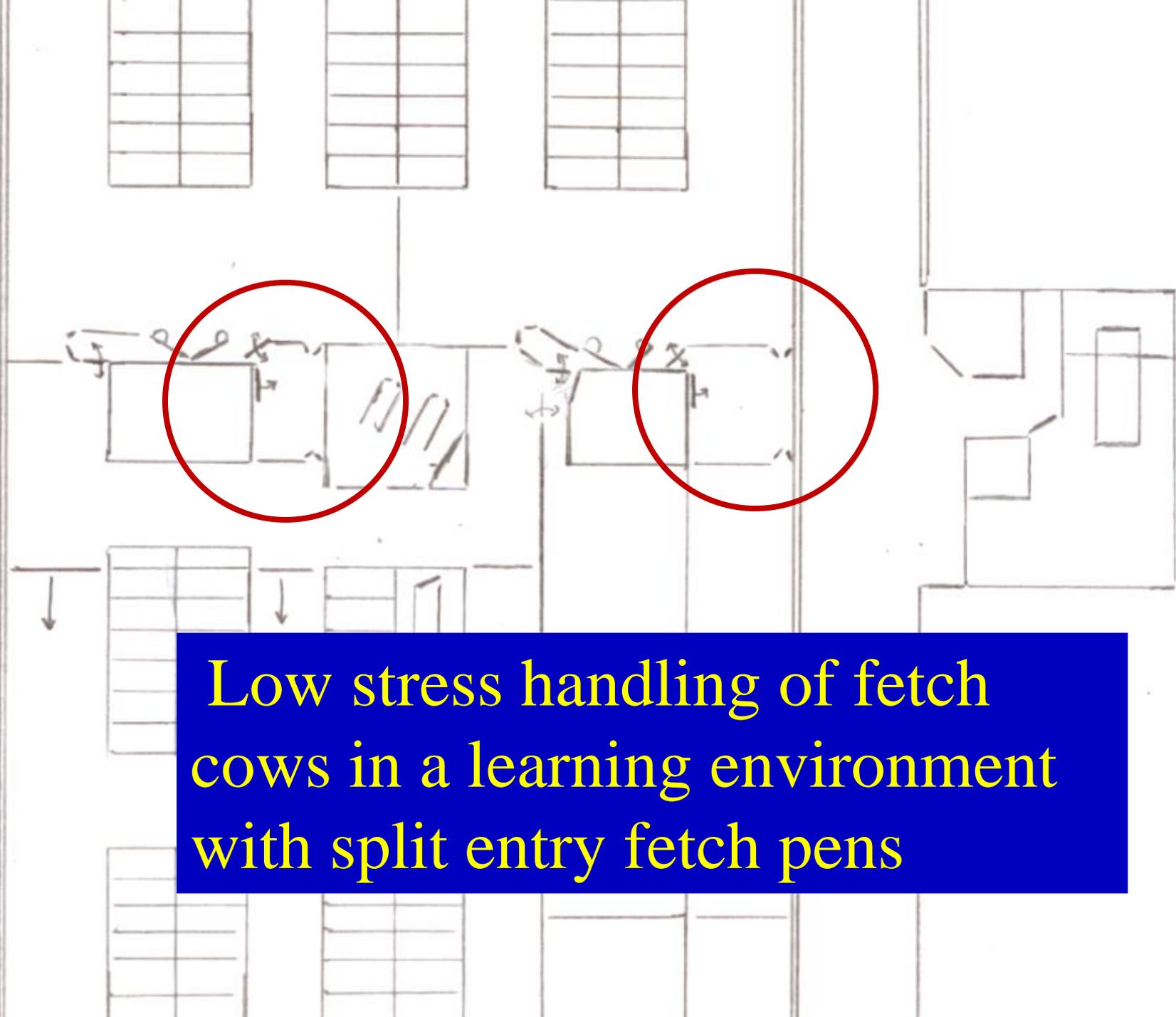
Milking

One man, working alone,  
should be able to move any  
cow to the handling area in  
one minute !

Dry

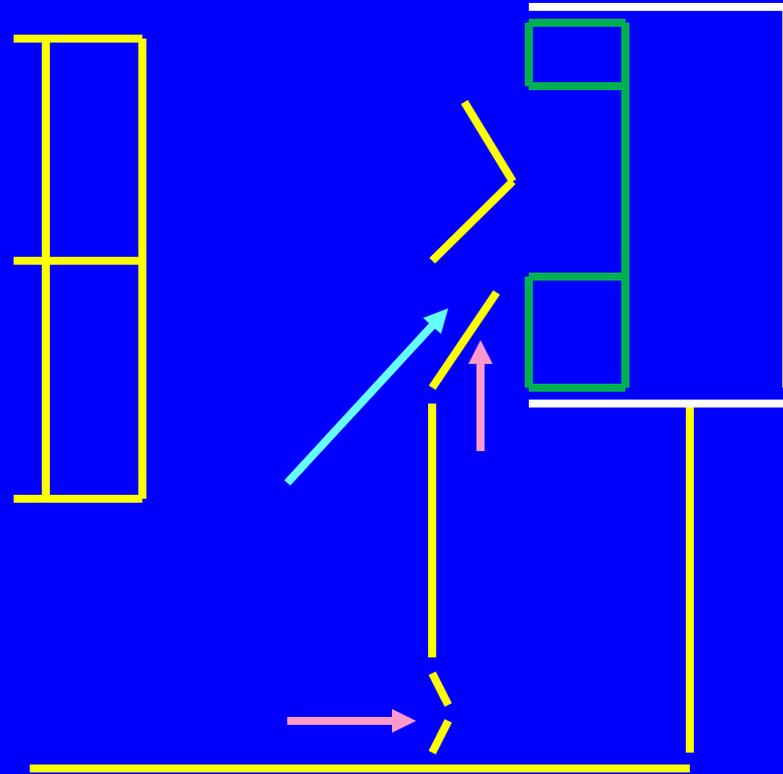
Calving

Close Up



Low stress handling of fetch cows in a learning environment with split entry fetch pens

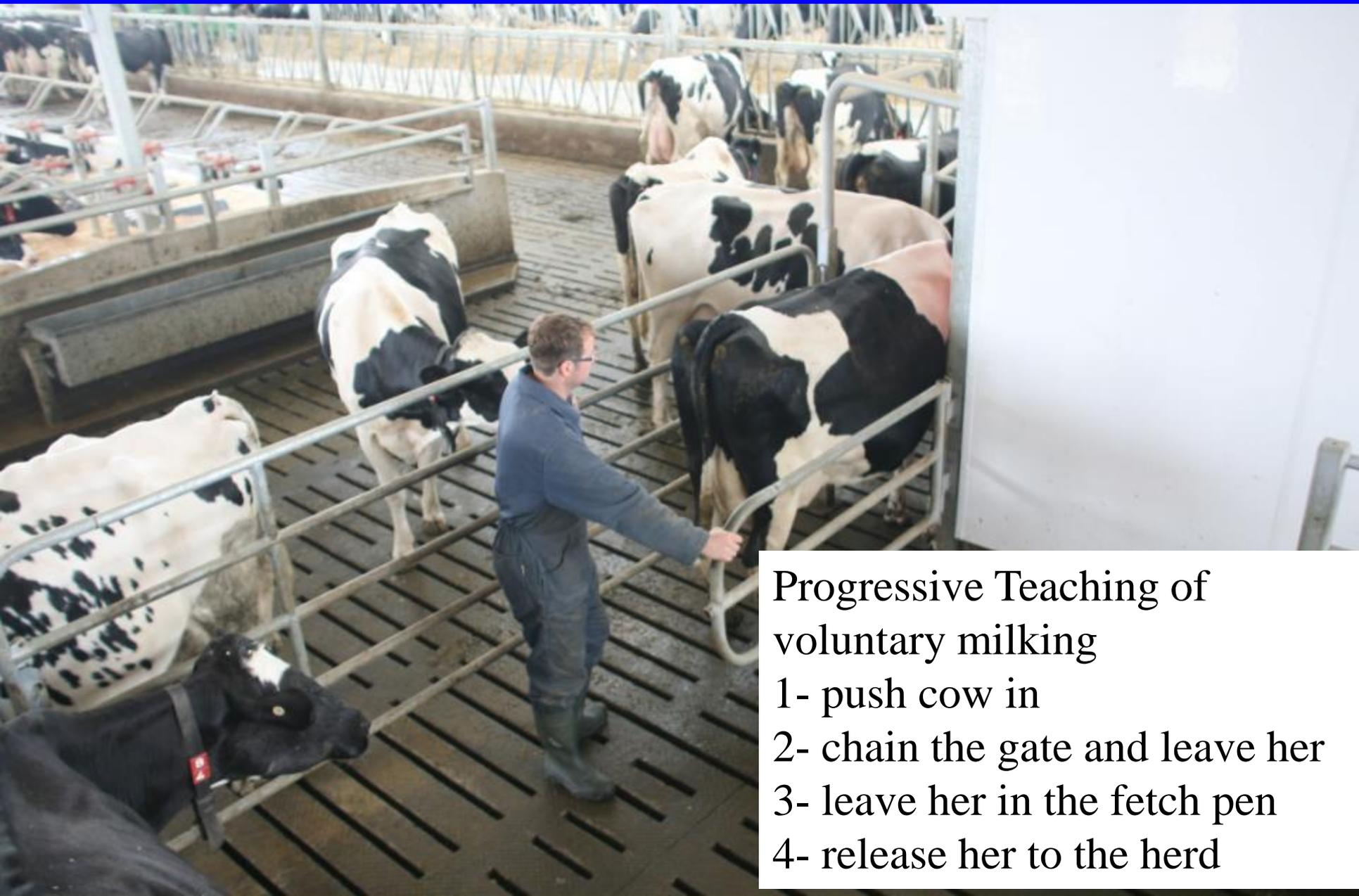
# Split Entry Fetch Pen for Fetched Cows Only



# Advantages of split robot entry



- Timid, fetched cows are not stressed by boss cows coming through the pen
- Cows in the herd have robot access while fetched cows are in the pen
- Fetched cows still have to compete a little, and are rewarded for positive behaviour.
- The farmer can leave the barn
- Potential for “automation”



## Progressive Teaching of voluntary milking

- 1- push cow in
- 2- chain the gate and leave her
- 3- leave her in the fetch pen
- 4- release her to the herd



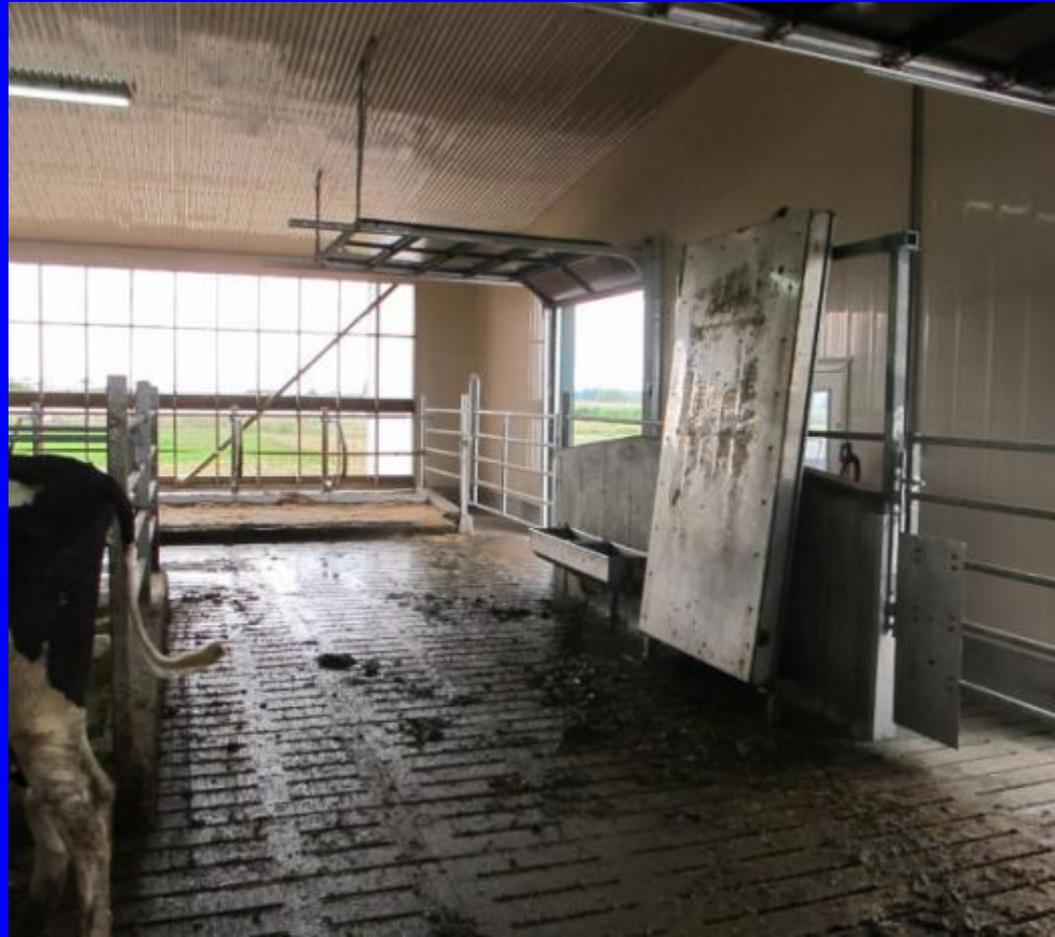
A split entry fetch pen and an exit lane encourage high throughput



Footbath at the robot exit discourages visits ?

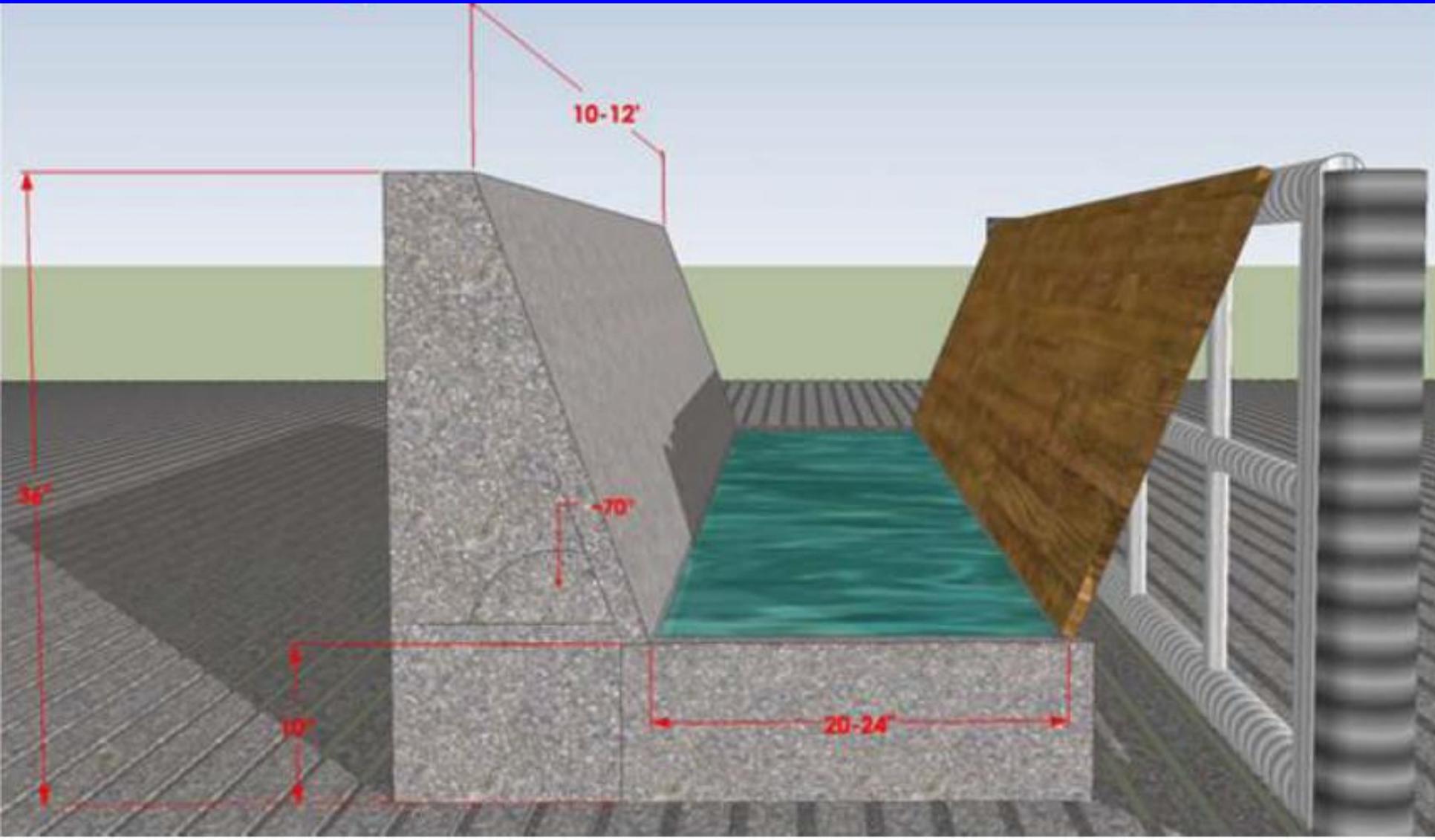
# I prefer a footbath in a remote crossover – once a week walk all cows through it twice

- Less disruptive to robot visits
- All cows get 2 passes
- Fresh chemical works better
- Keeps chemical away from milk and delicate metal parts
- Less work, especially in large groups

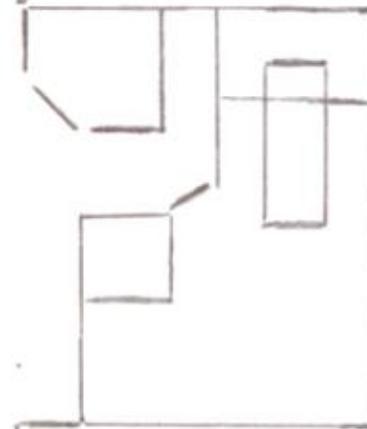
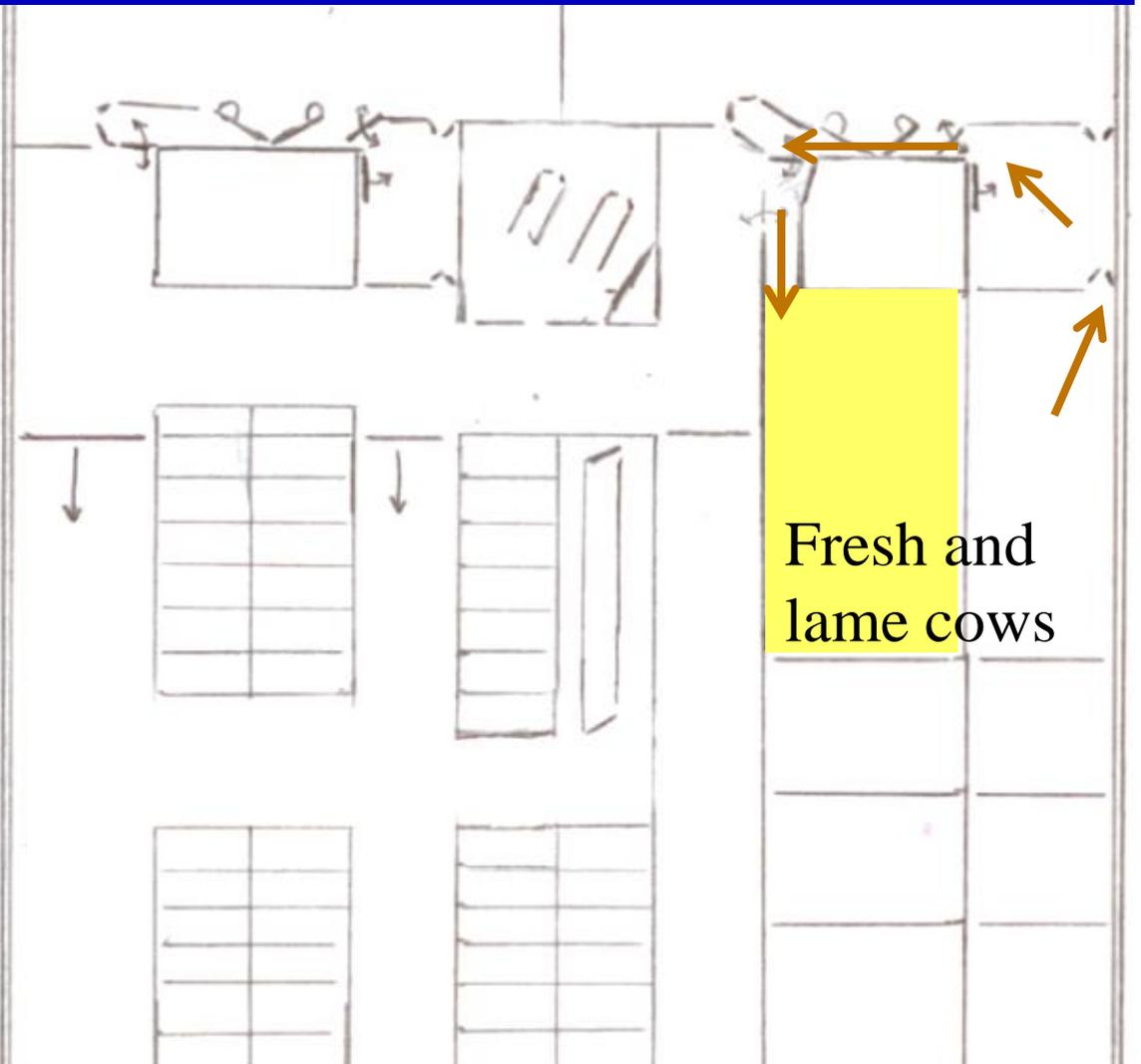




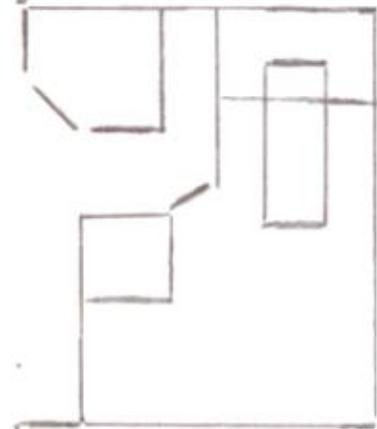
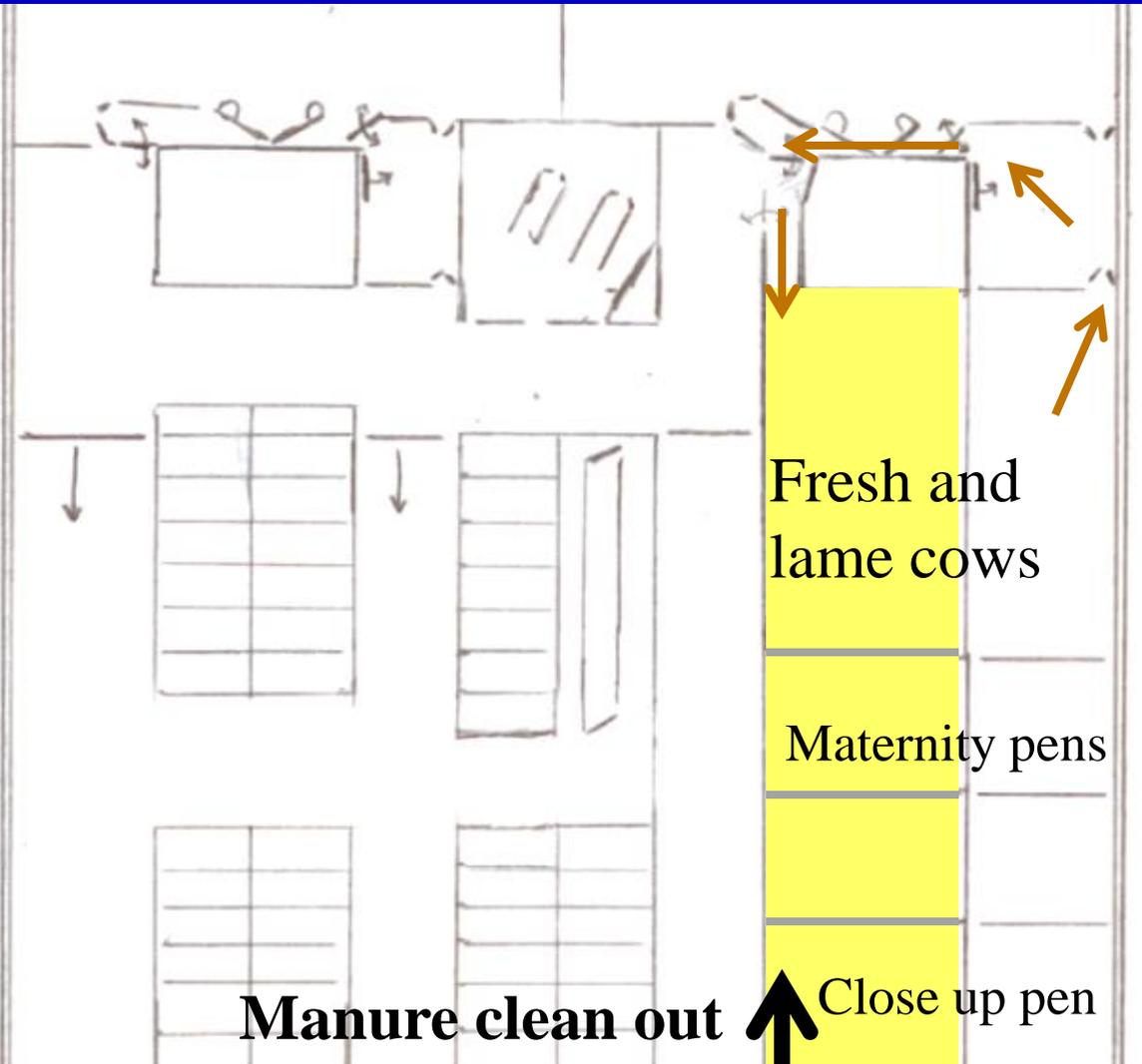
# Nigel Cook design



# Maximum comfort for fresh and lame cows in a bedding pack with robot access

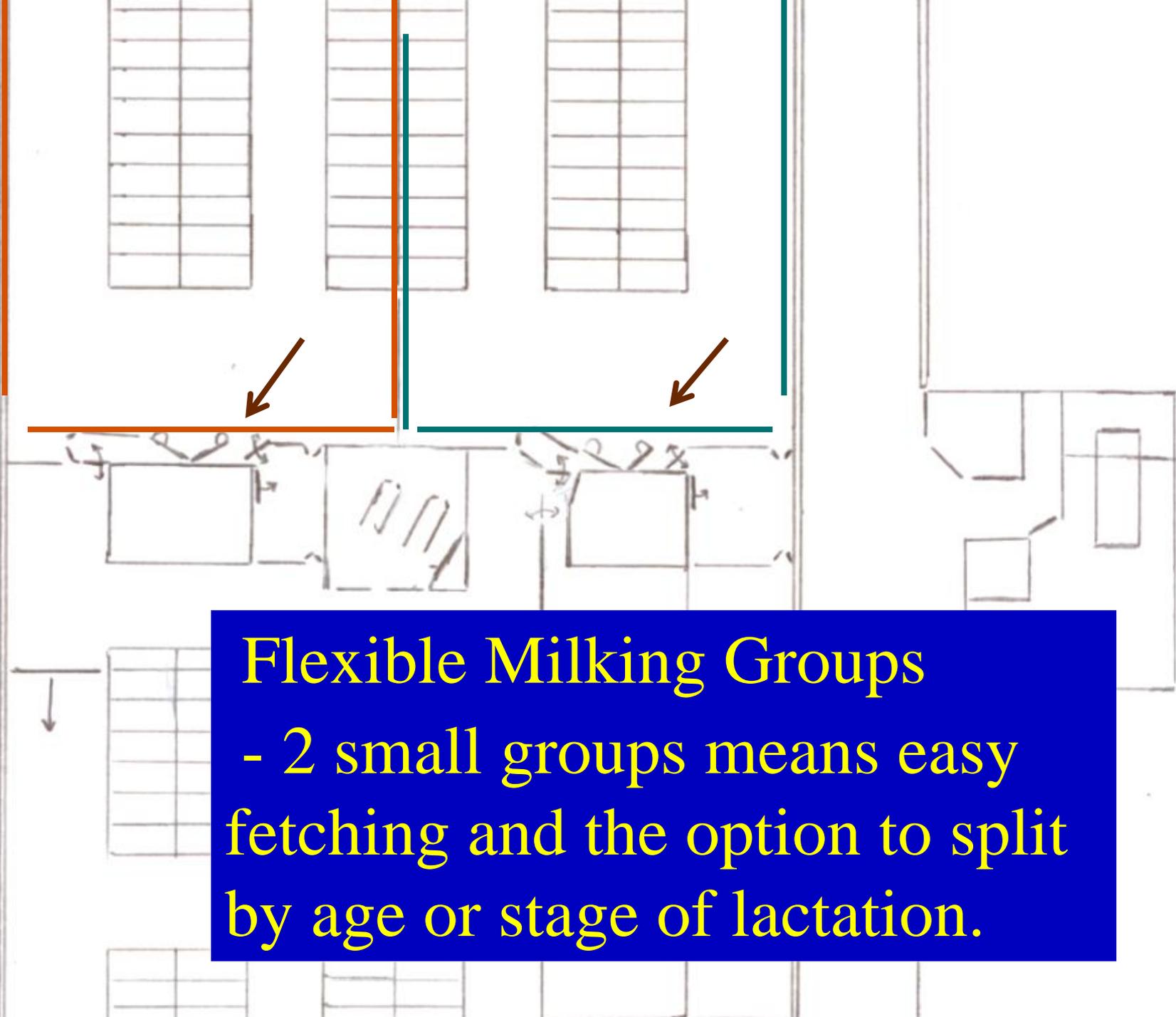


# A stress free calving line with close up, calving and fresh cows side by side in bedding packs

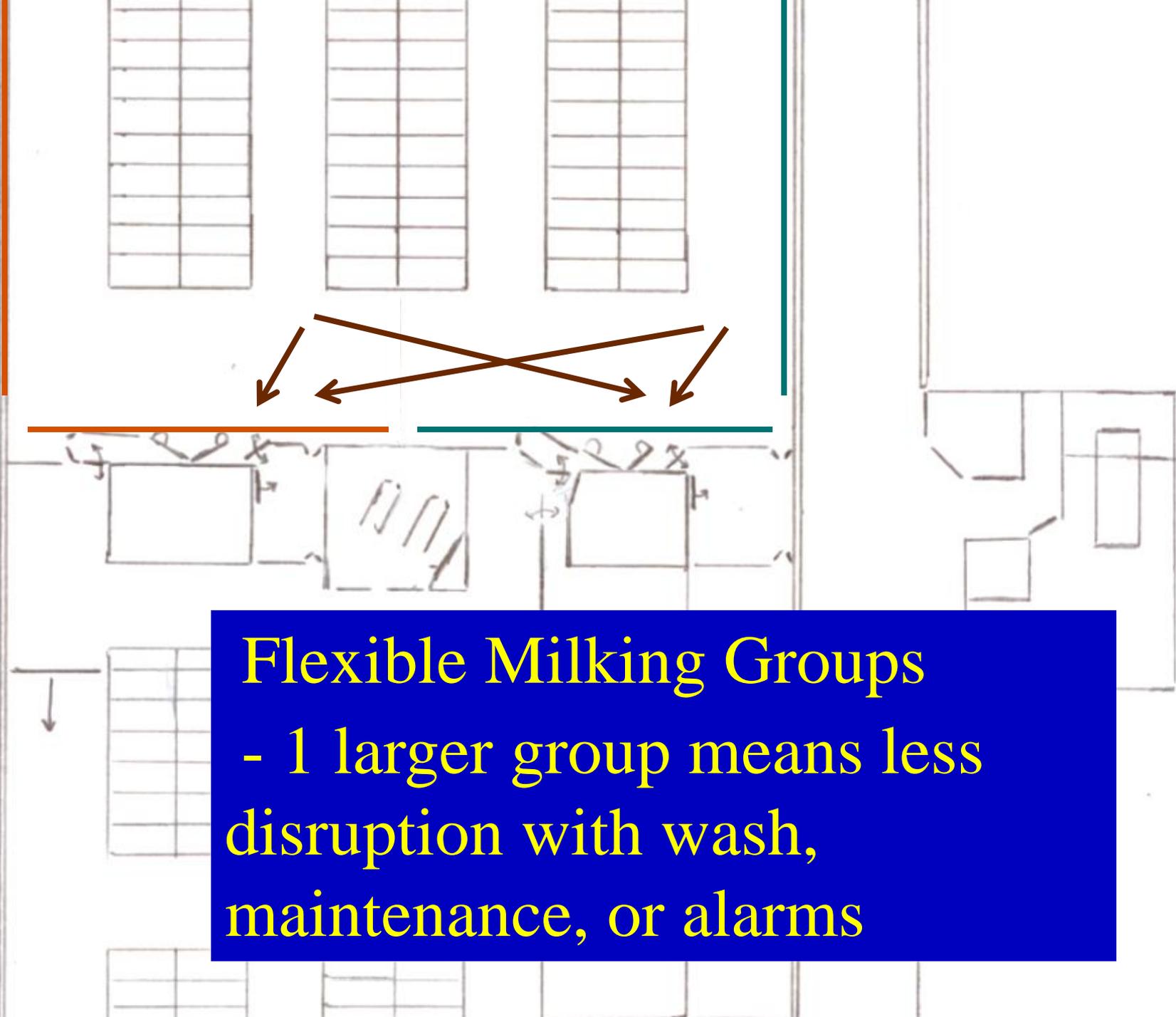


Calving area behind the robot brings the fresh cow back to the fetch pen





**Flexible Milking Groups**  
- 2 small groups means easy fetching and the option to split by age or stage of lactation.



**Flexible Milking Groups**  
- 1 larger group means less disruption with wash, maintenance, or alarms

# New labor demands with robotics

- There is no fixed milking time so cow handling gets more complicated
- Many herds create new work handling cows in free stalls
- A common conclusion is that all robot barns should have headlocks throughout

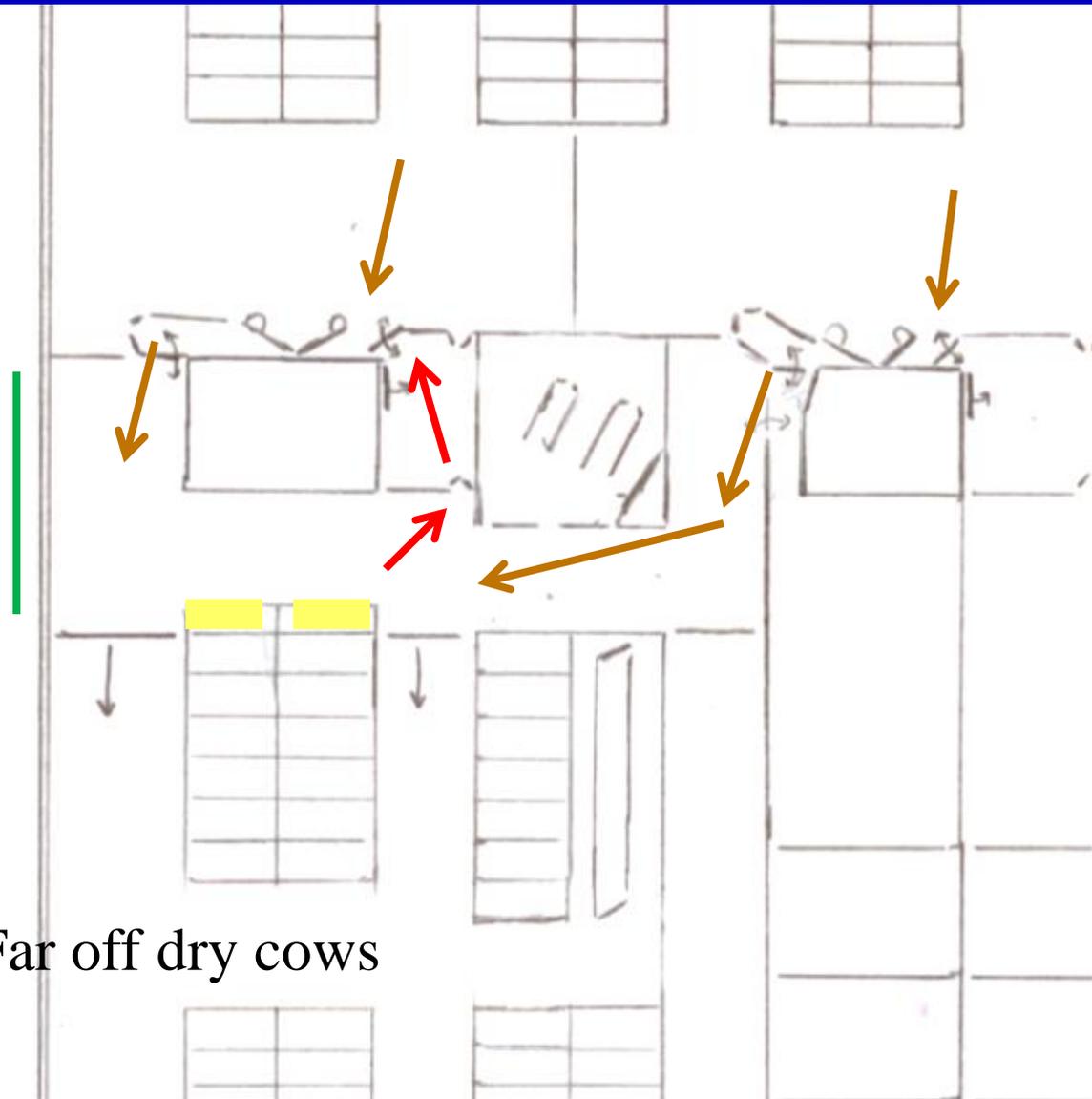
# I Disagree

- Just like handling in a parlor, handling at the manger gives cows a bad experience in a good place.
- Locking up all cows to handle 20% creates unnecessary stress. Releasing 80% adds further stress to those remaining.
- Bringing tools, drugs, etc. to cows spread along the entire manger makes it work for two people and more time consuming

# A handling system based on separation

- Sort post milking over a 12 hour period to collect cows for handling
- Provide a chute for hoof trimming and headlocks, a second chute, or a management rail for group handling. . . .like flaming udders
- Design all gates, cow routing etc. so one person can work alone.

# Flexible separation area gated for 2 stalls

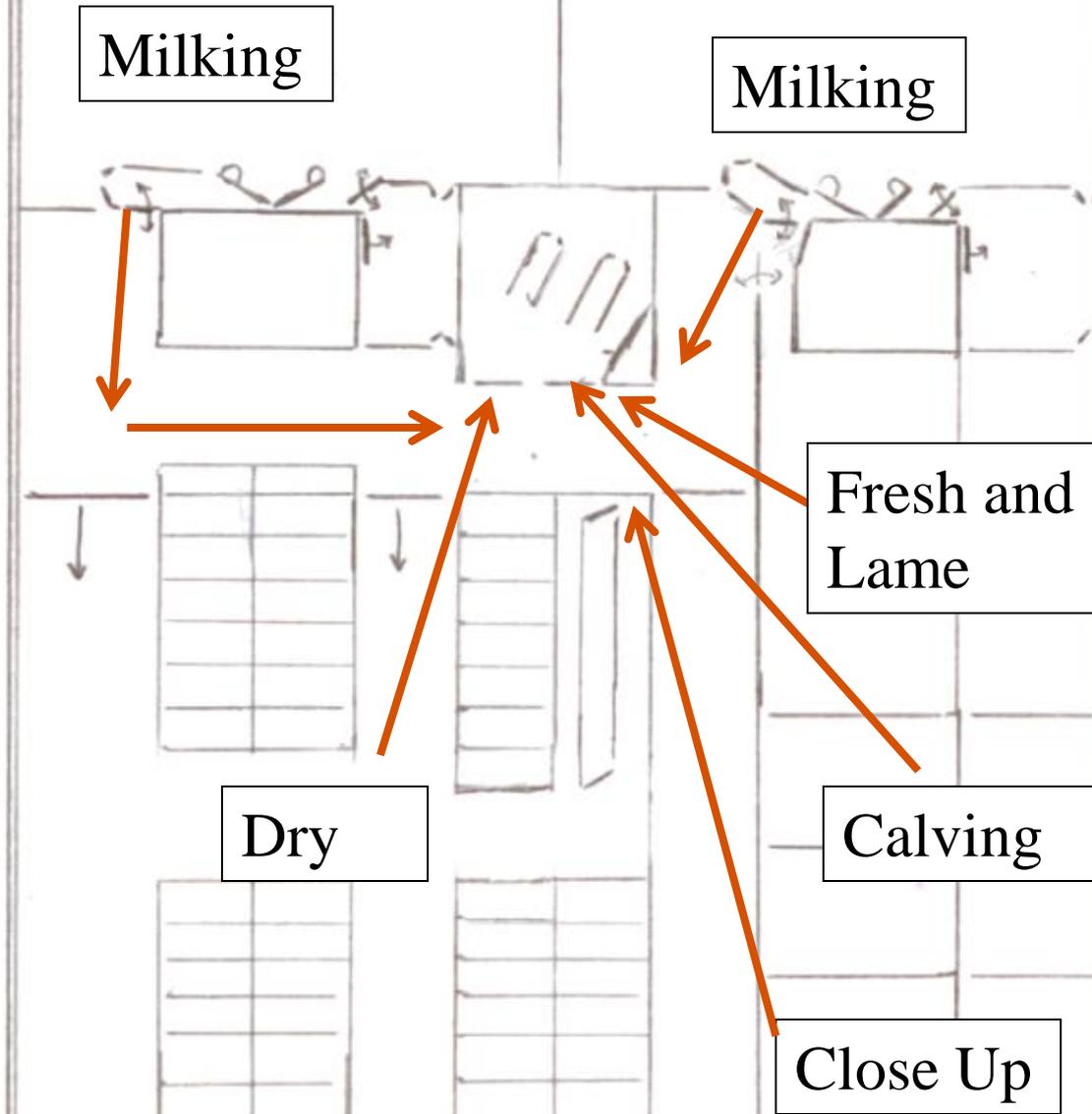


Far off dry cows

## 3 way sort at the robot exit



# Direct access by all groups to central handling





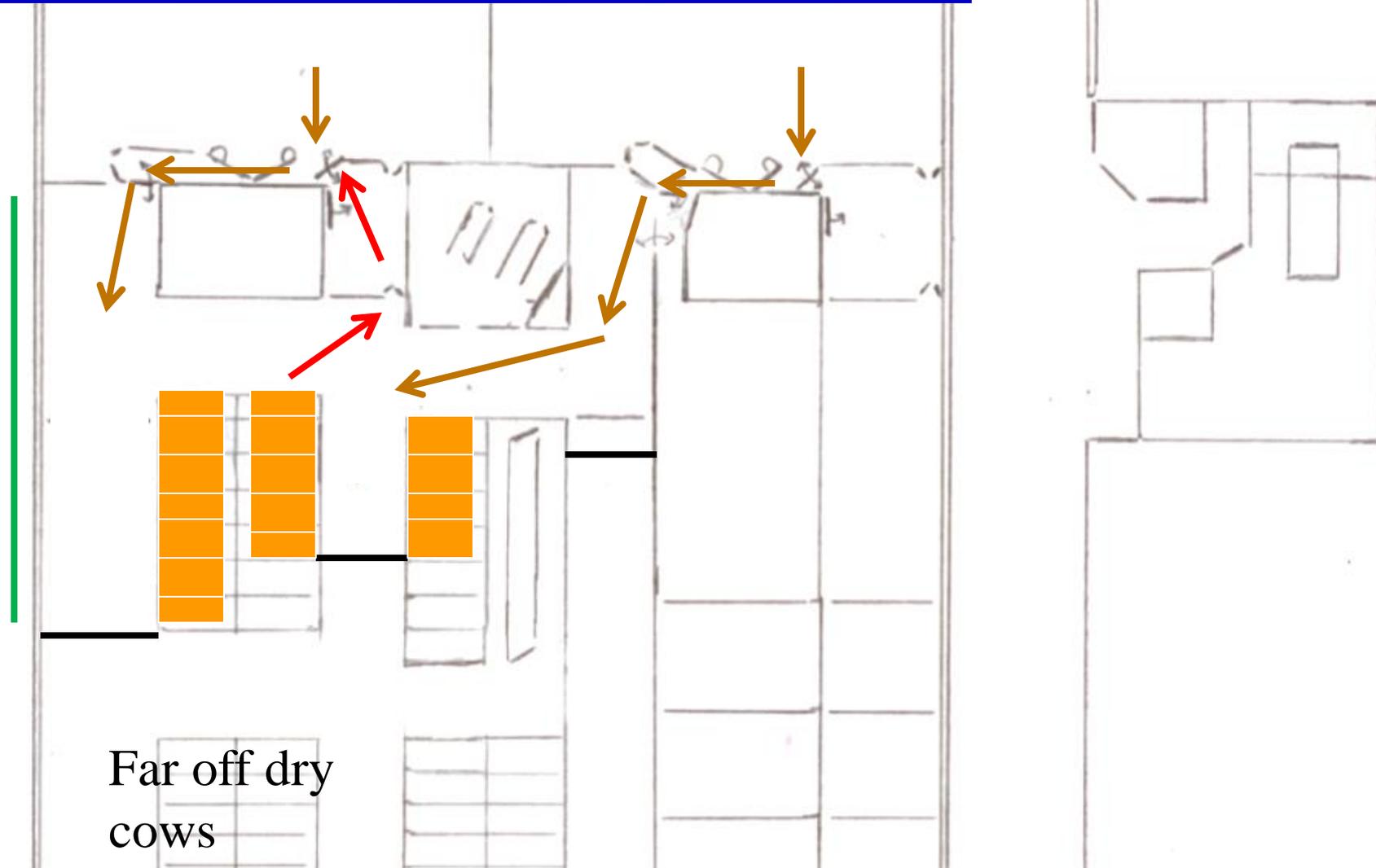
Handle individual cows in the chute

# Strategic Placement of Computer, equipment storage, water and hydro in the handling area.



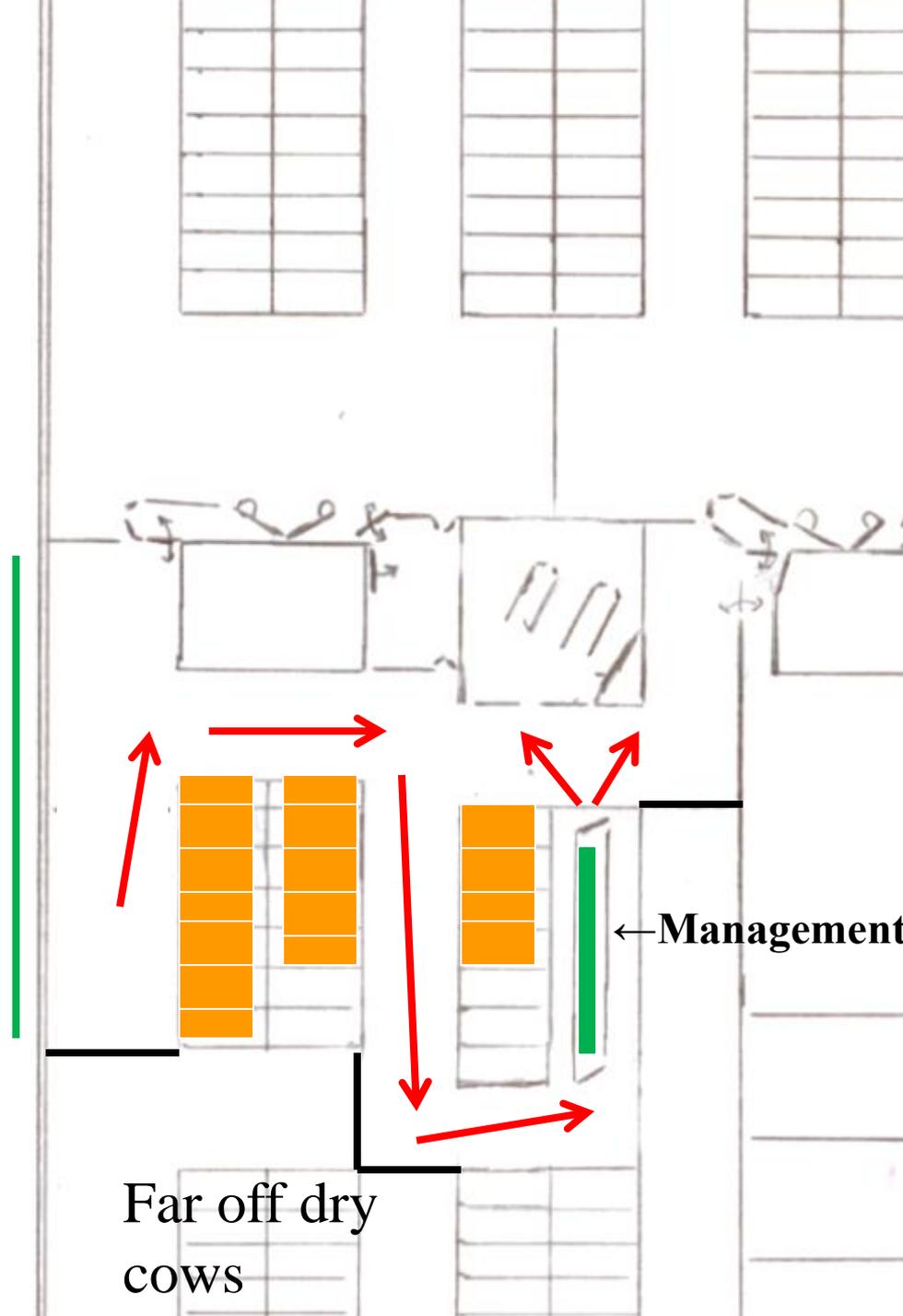


Flexible separation area gated for 16 stalls, including 14 borrowed from far off dry cows





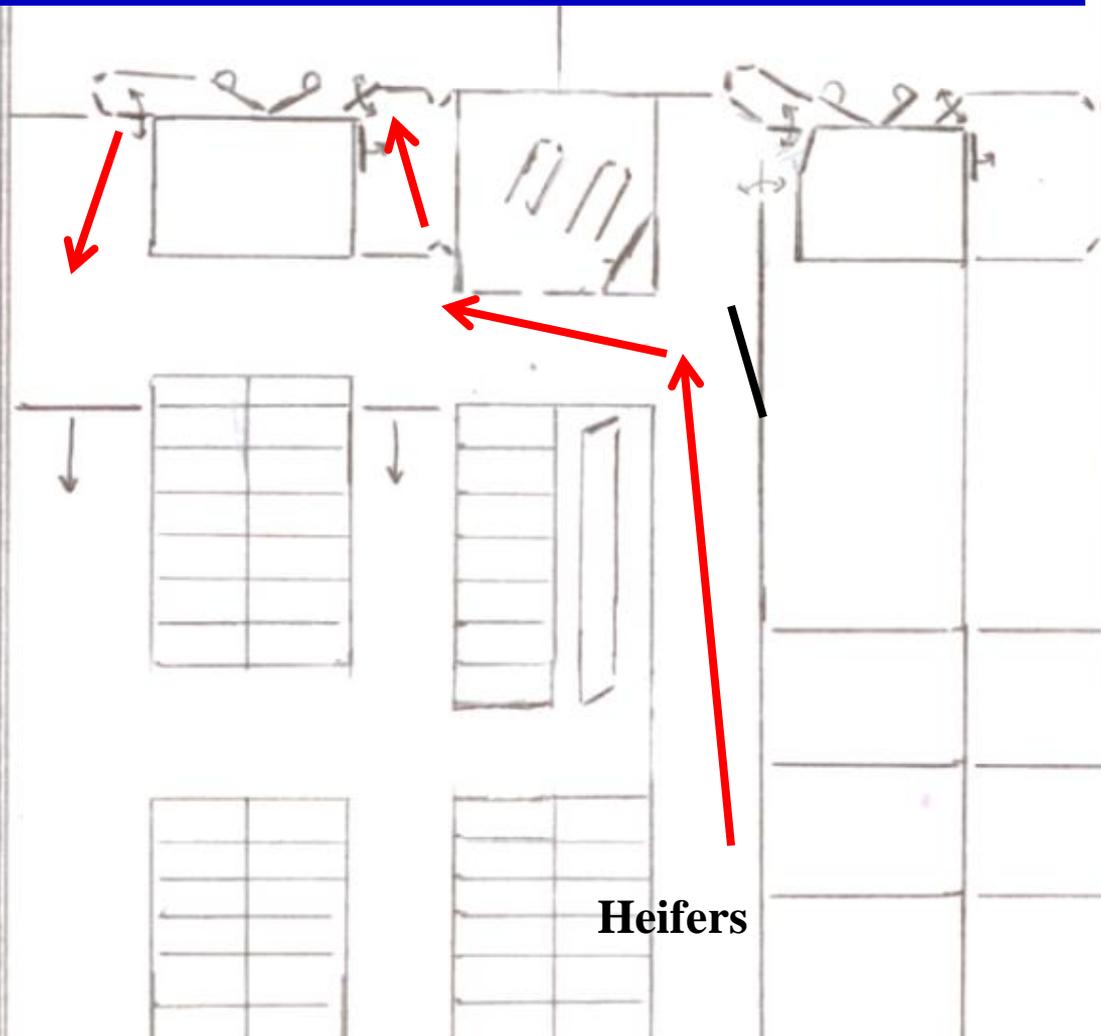
Handle groups in headlocks in the separation area, or in a management rail



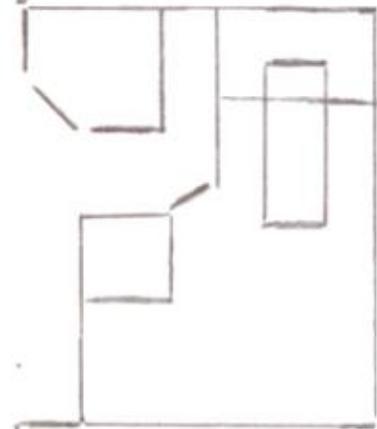
Far off dry  
COWS

← Management rail

When not separating cows,  
train older heifers 3 weeks  
before calving



Heifers

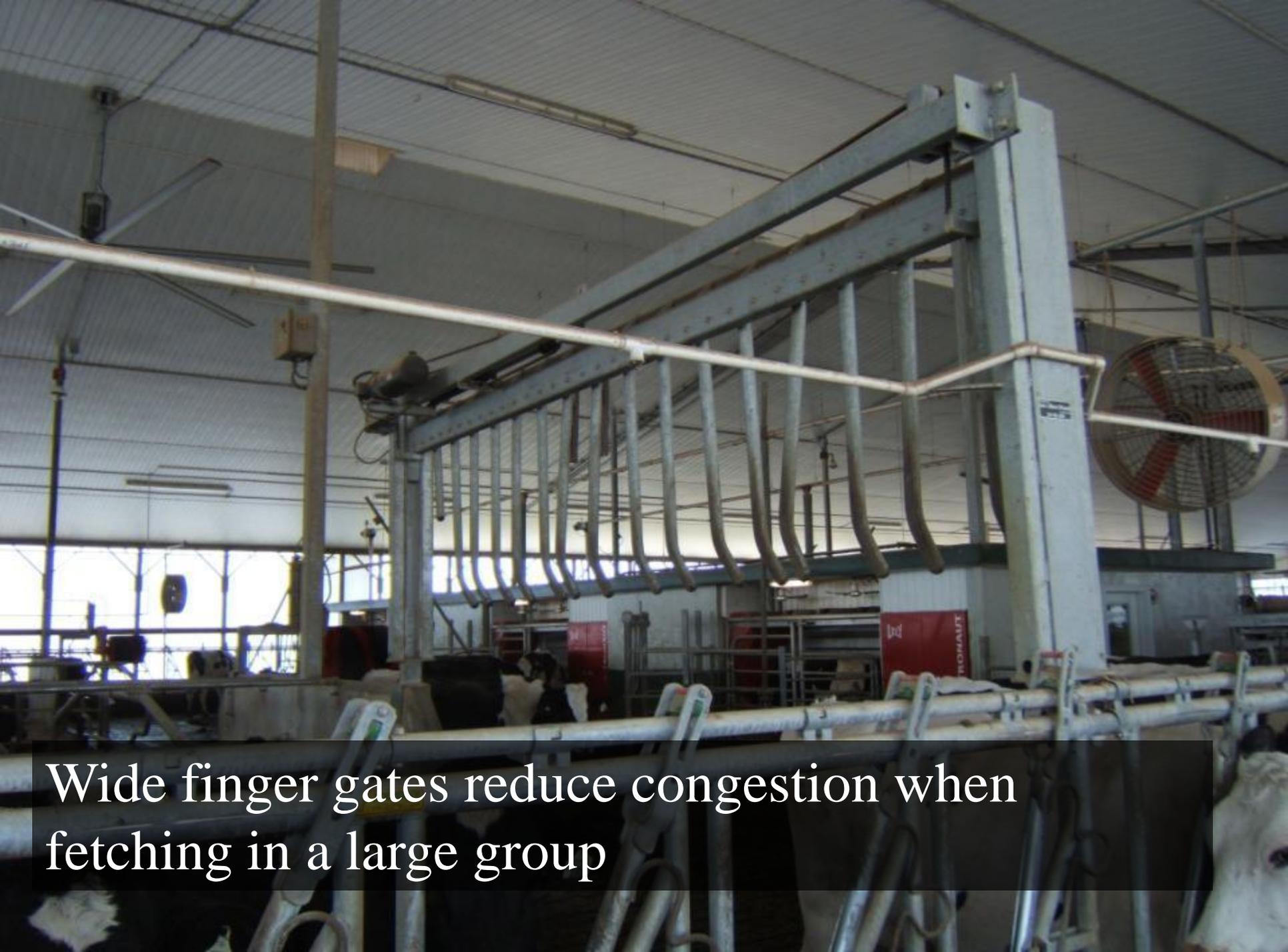


# Train Cows and Heifers to use One Way Gates before calving



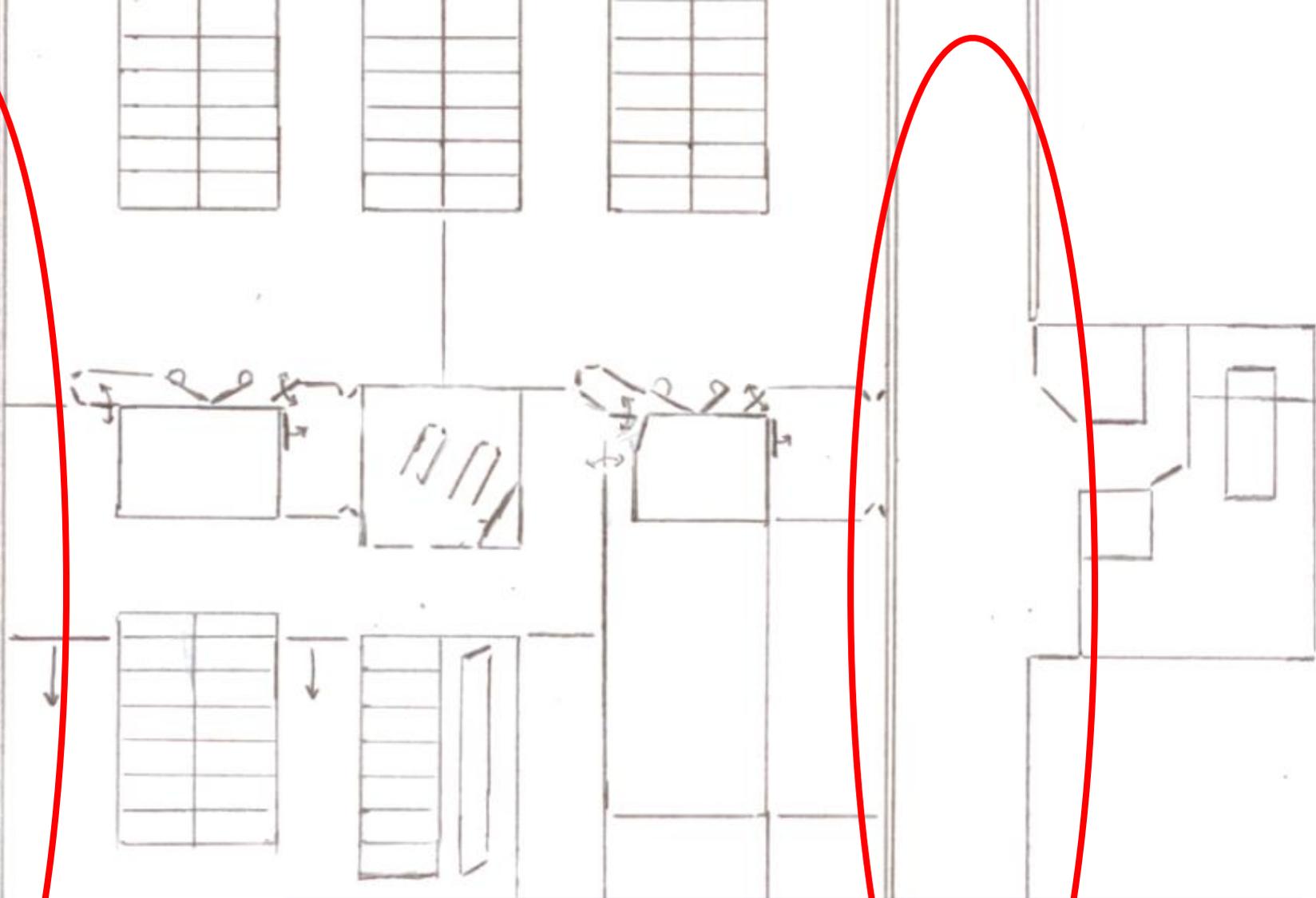


Wide finger gates reduce congestion in forced traffic barns



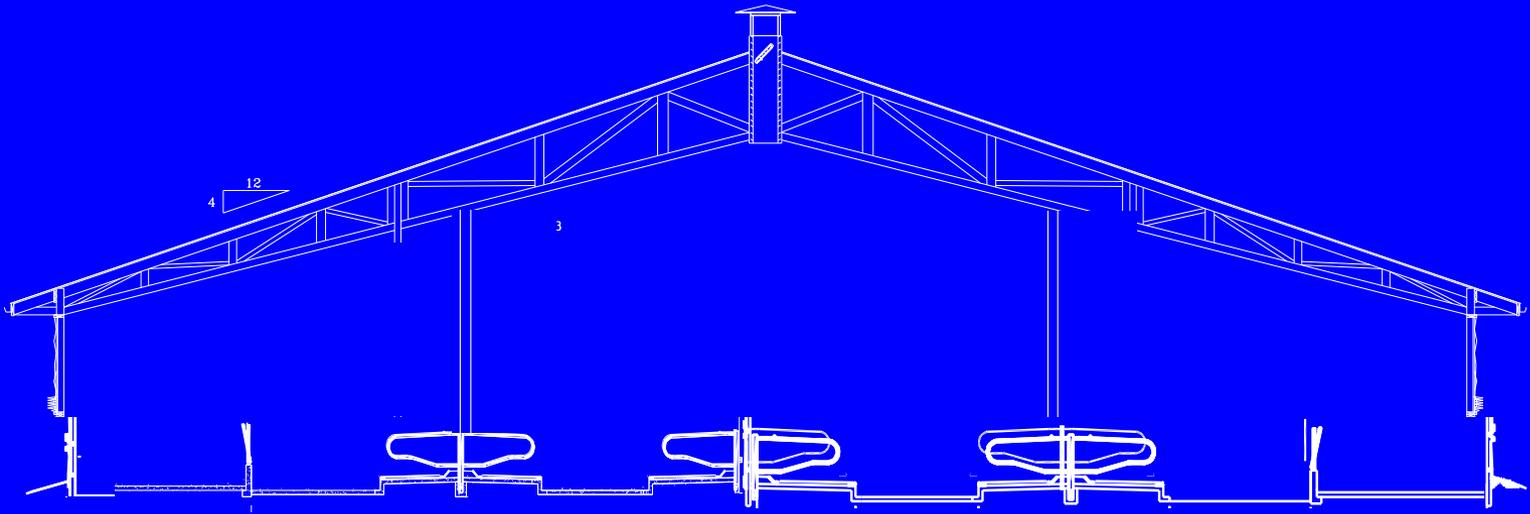
Wide finger gates reduce congestion when fetching in a large group





Perimeter feeding for central handling, flexible group sizes,

6 - 8 feet wider than center drive through



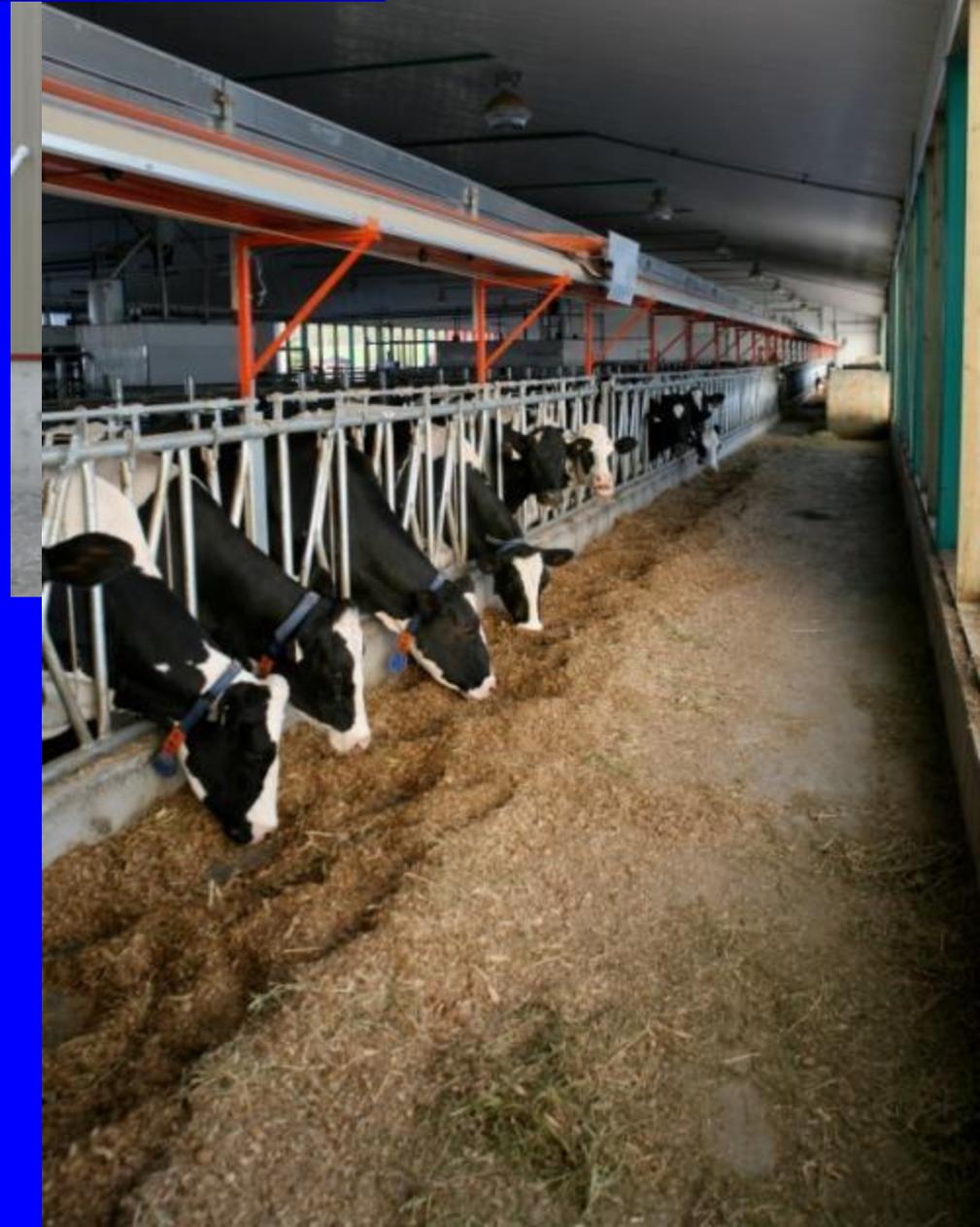
- No rain, sun or frost in the stalls or manure alleys

Requires a 14 ft  
high sidewall for  
trailer mixers



# Perimeter feeding

Automated feed  
delivery saves  
space



[www.outsidefeeding.com](http://www.outsidefeeding.com)



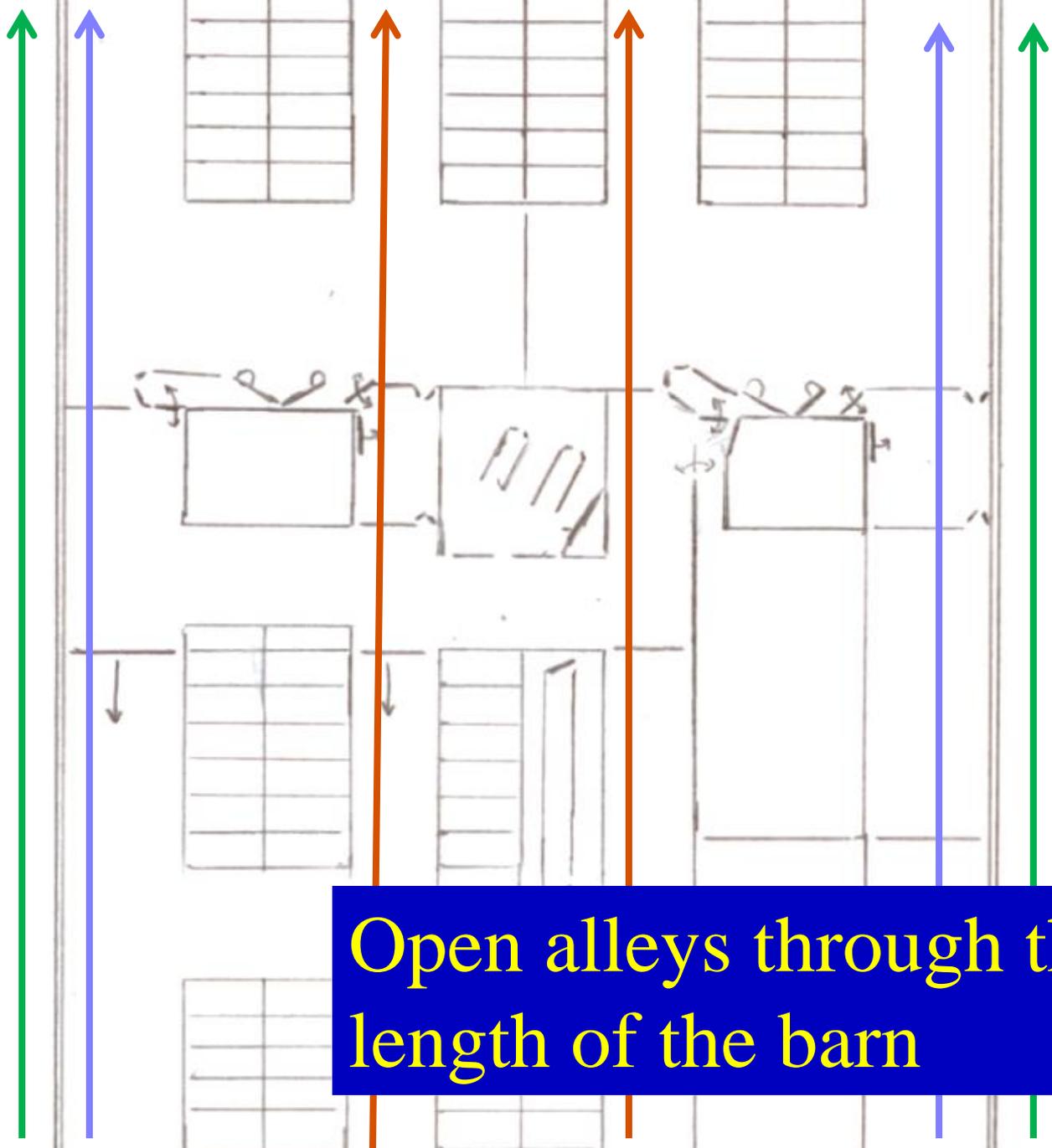


Cows don't leave the barn.....

..Big equipment is disruptive !



Straight wide, drive through alleys,  
big crossovers and free traffic minimize  
disruption of the cows



Open alleys through the full length of the barn



Forced traffic means cows displaced  
from an alley cannot go back

# Choose mattress systems that require minimal bedding



Or automate bedding delivery





Flex augur runs in this barn are up to 180 feet long and drop sawdust at the common corner of four stalls



# Automatic Bedding Delivery

- Artex and Jamesway are working together on belt systems



**Tractor scraping disturbs cows and is not an option (slats, scrapers or flush)**



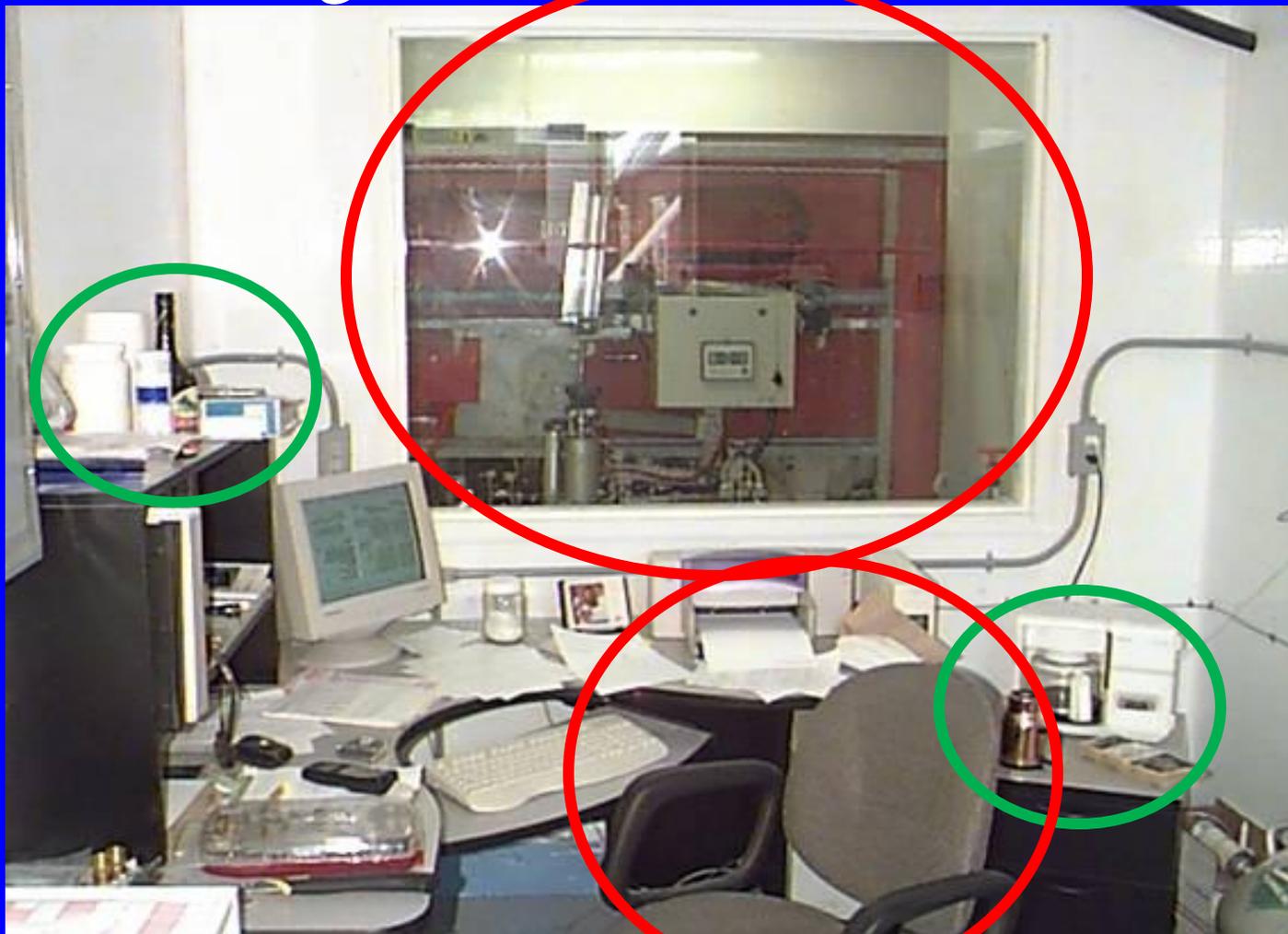
# Prevent Lameness with Tube Scrapers

- The manure bath in front of mechanical alley scrapers leads to clean barns and dirty diseased feet
- Norbco and Jamesway both offer tube systems.
- Great drainage, less cable wear, but some design issues and challenges.
- \$65/ft adds \$250/cow



# A robot farmer spends more time in the office and less in the barn

Is this a good farm office ??



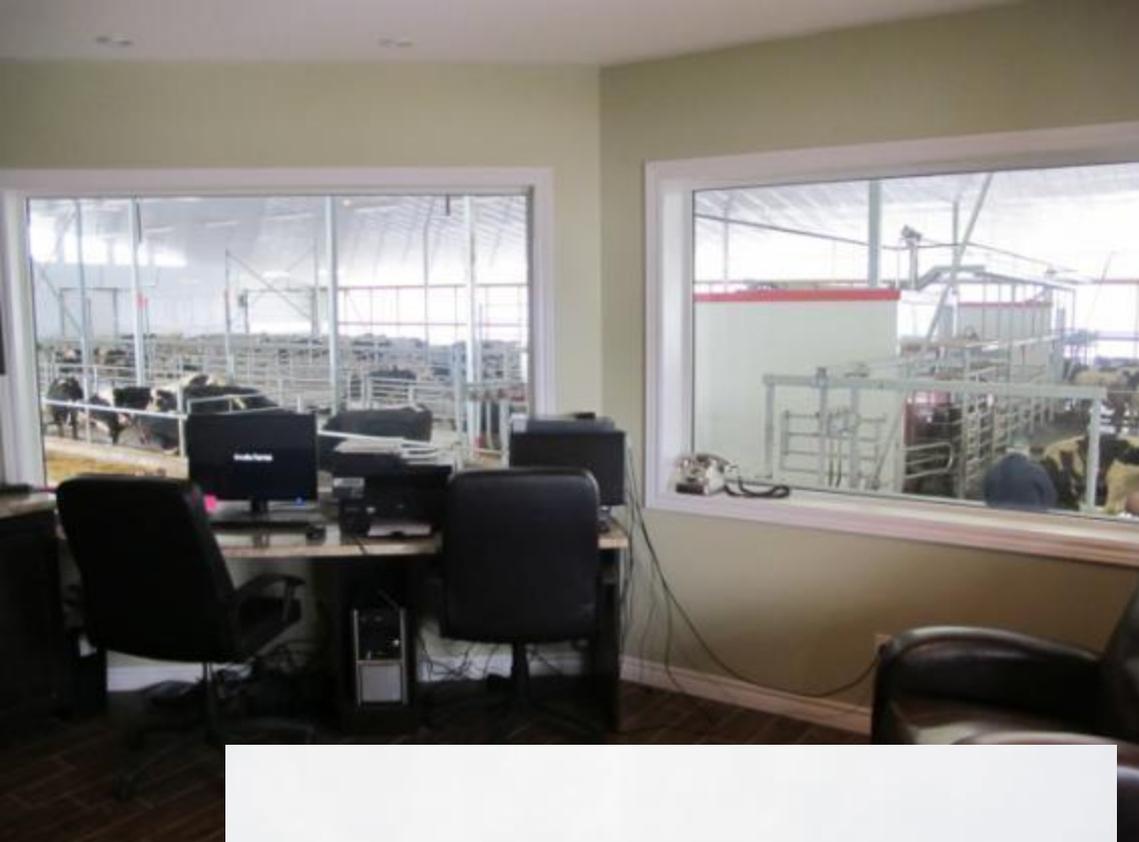


## Windows onto:

1. Calving area
2. Cows in front of the robot
3. The approach to the barn outside

High terminal for stand up access, bar stool for longer jobs

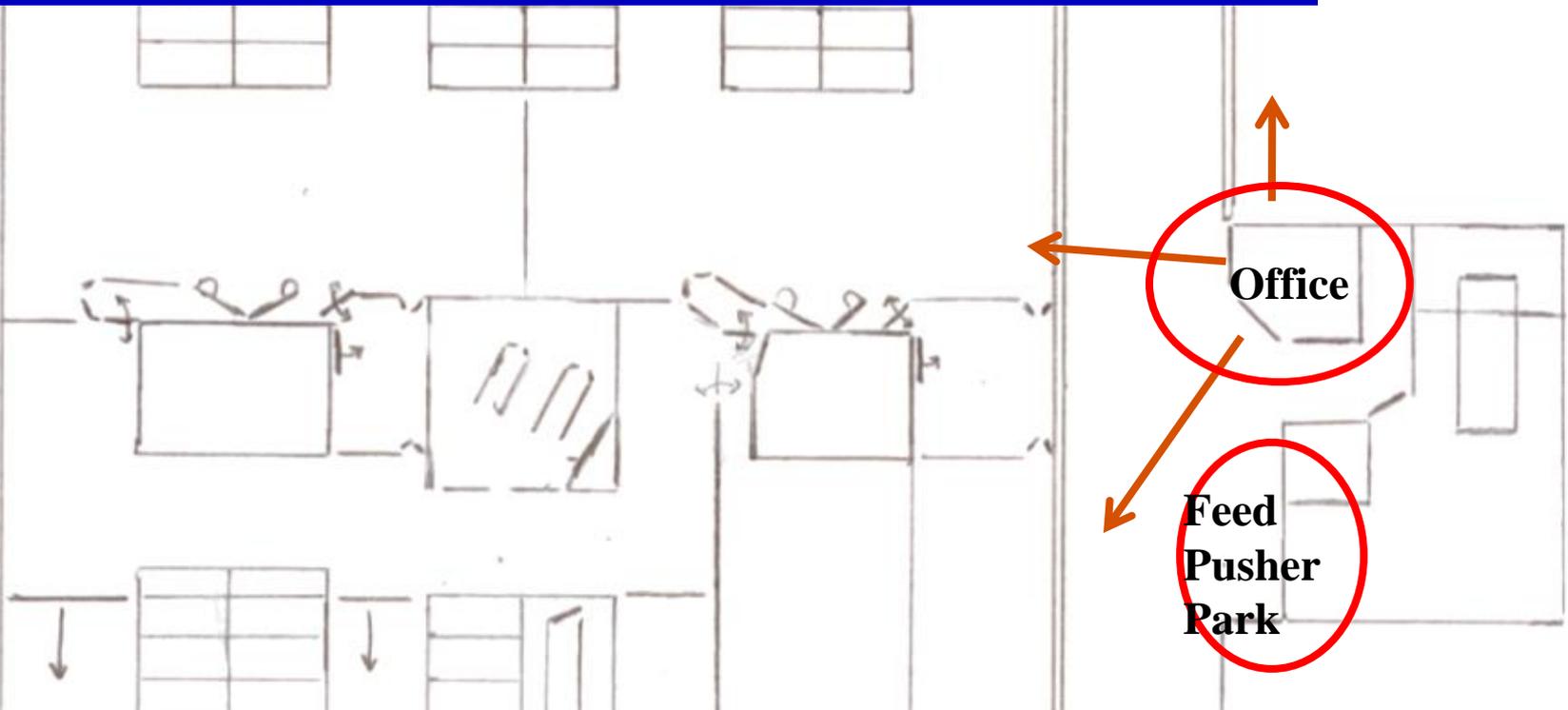
Easy to clean surfaces .....or a separate stand up terminal in the hallway



Office area with a good overview of the front of the robot, the calving pen and the yard.

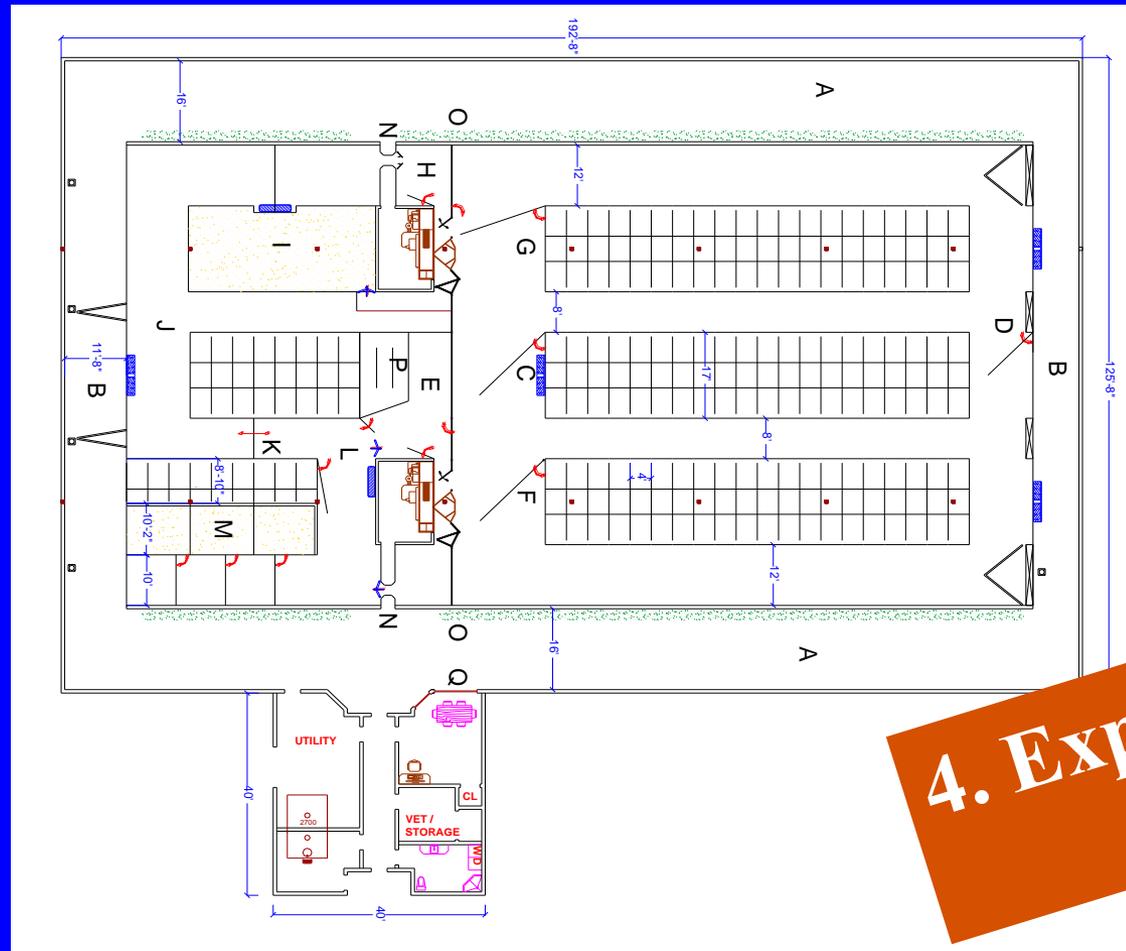


Office area with a good overview of the front of the robot, the calving pen and the yard.



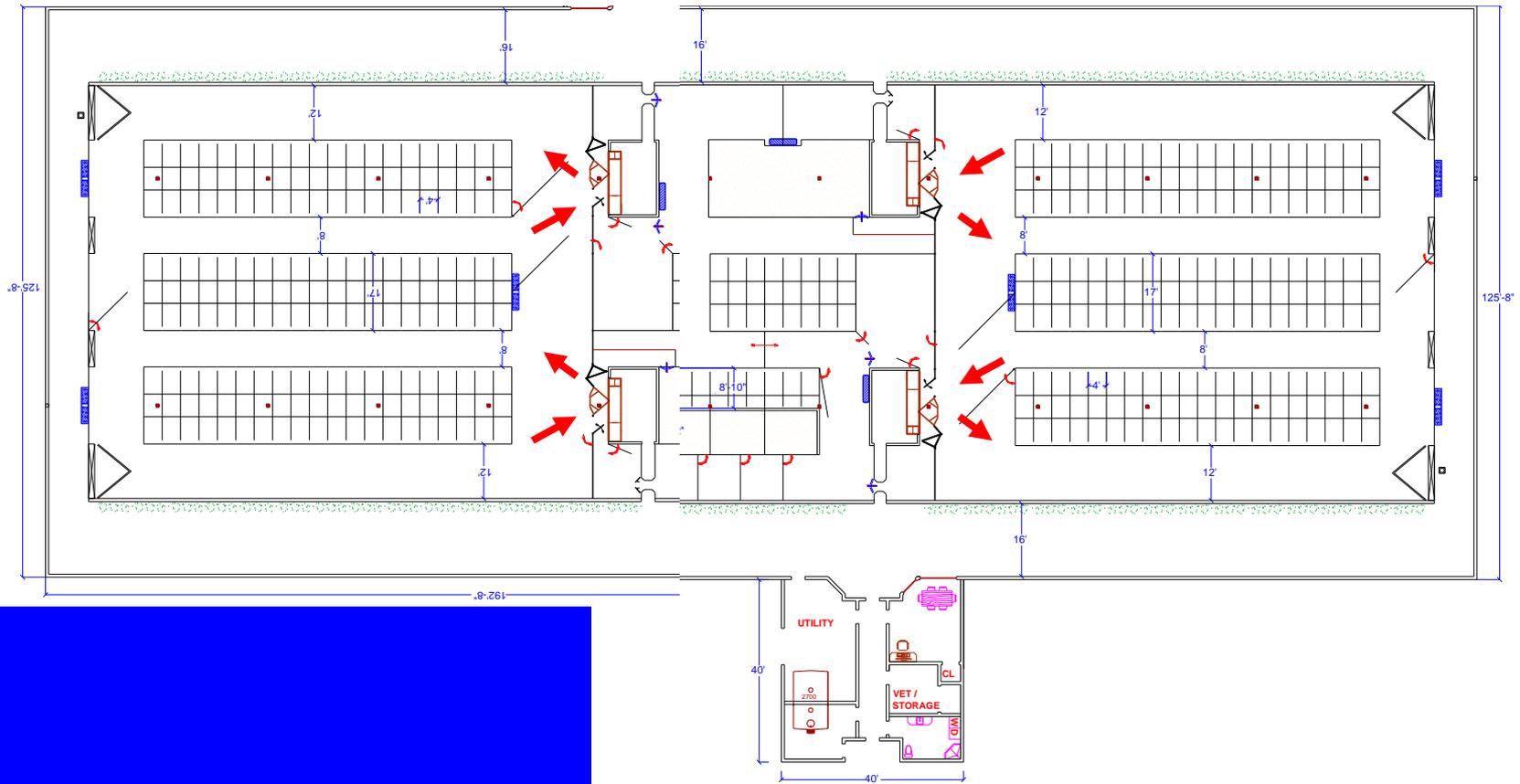
and a spot to park the feed pusher

# The Corner Stones of Dairy Housing Design



**4. Expandable**

# Expandable to 4 robots, 240 milking cows

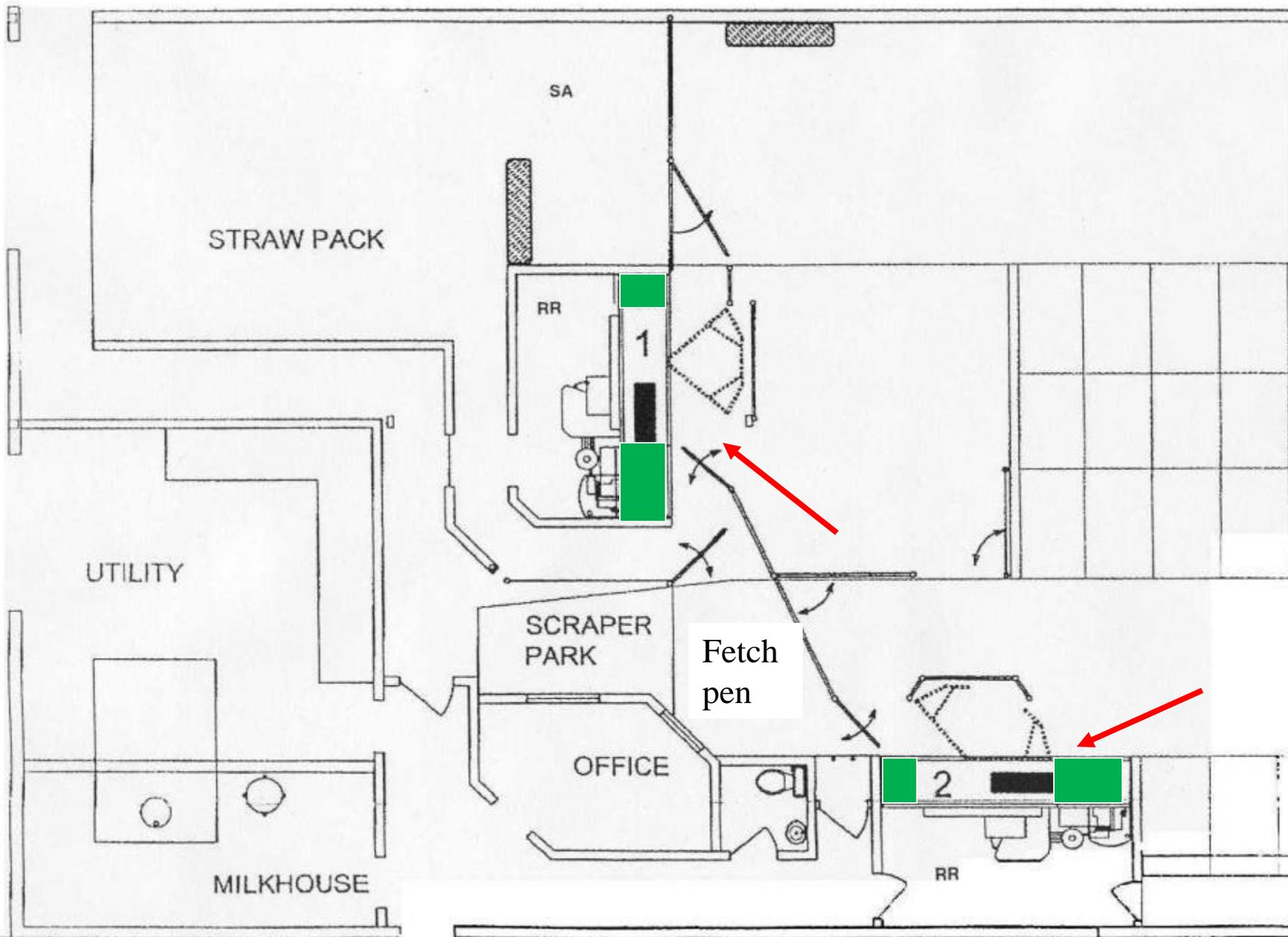


Two or four groups, central handling



In this “L” layout, robots are close together, highly visible, and both are left entry. Cross use is excellent

DRIVE-THROUGH FEED ALLEY



STRAW PACK

SA

RR

1

UTILITY

SCRAPER  
PARK

Fetch  
pen

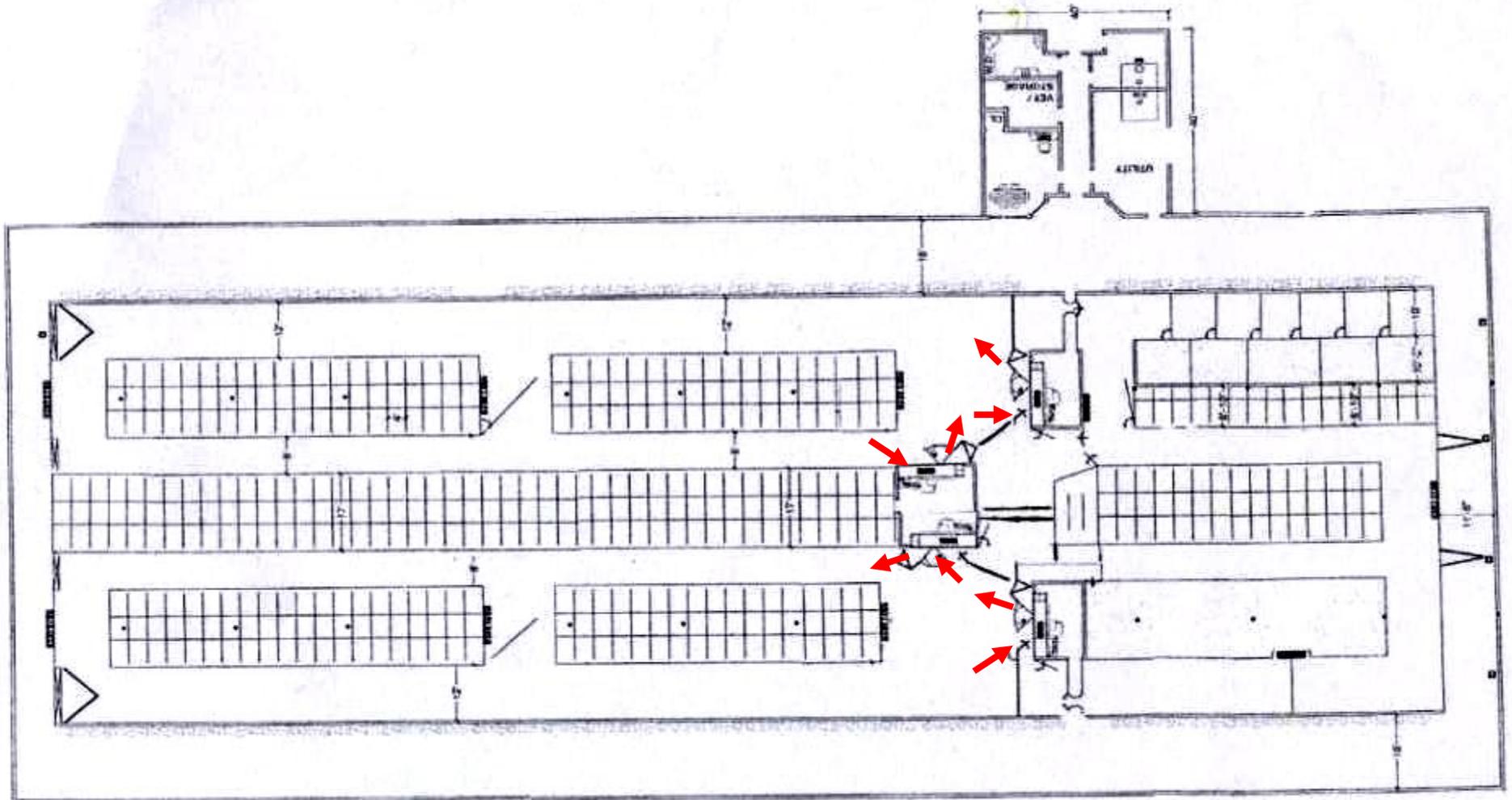
OFFICE

RR

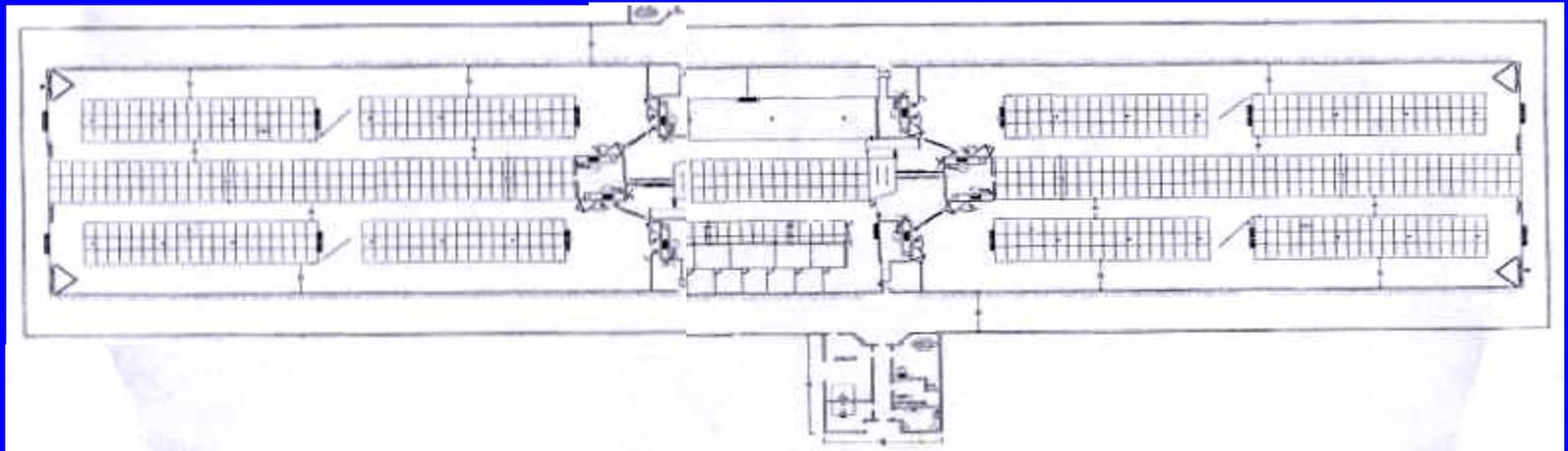
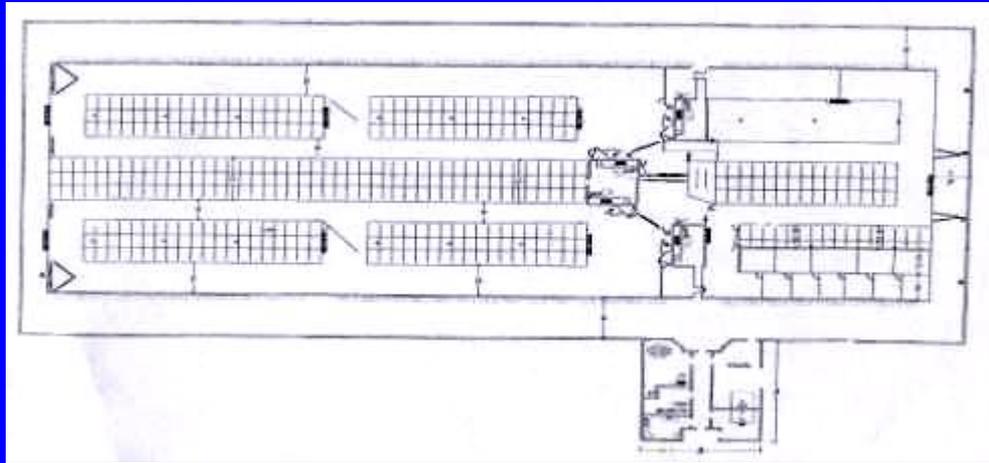
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MILKHOUSE

# Four Robots, Two Groups



# A Robot Barn for 240 cows expandable to 480



# Tollgate layout for Insentec and Boumatic double boxes



**Perimeter  
feeding**

**120 Comfortable Freestalls  
for Milking Cows**

**Perimeter  
feeding**

**↓ Fetch pen**

**Robot 1  
Robot 2**

**Bedding  
pack for  
fresh and  
lame cows**

**↓ Tank**

**Office**

**Utility**

**Management rail →**

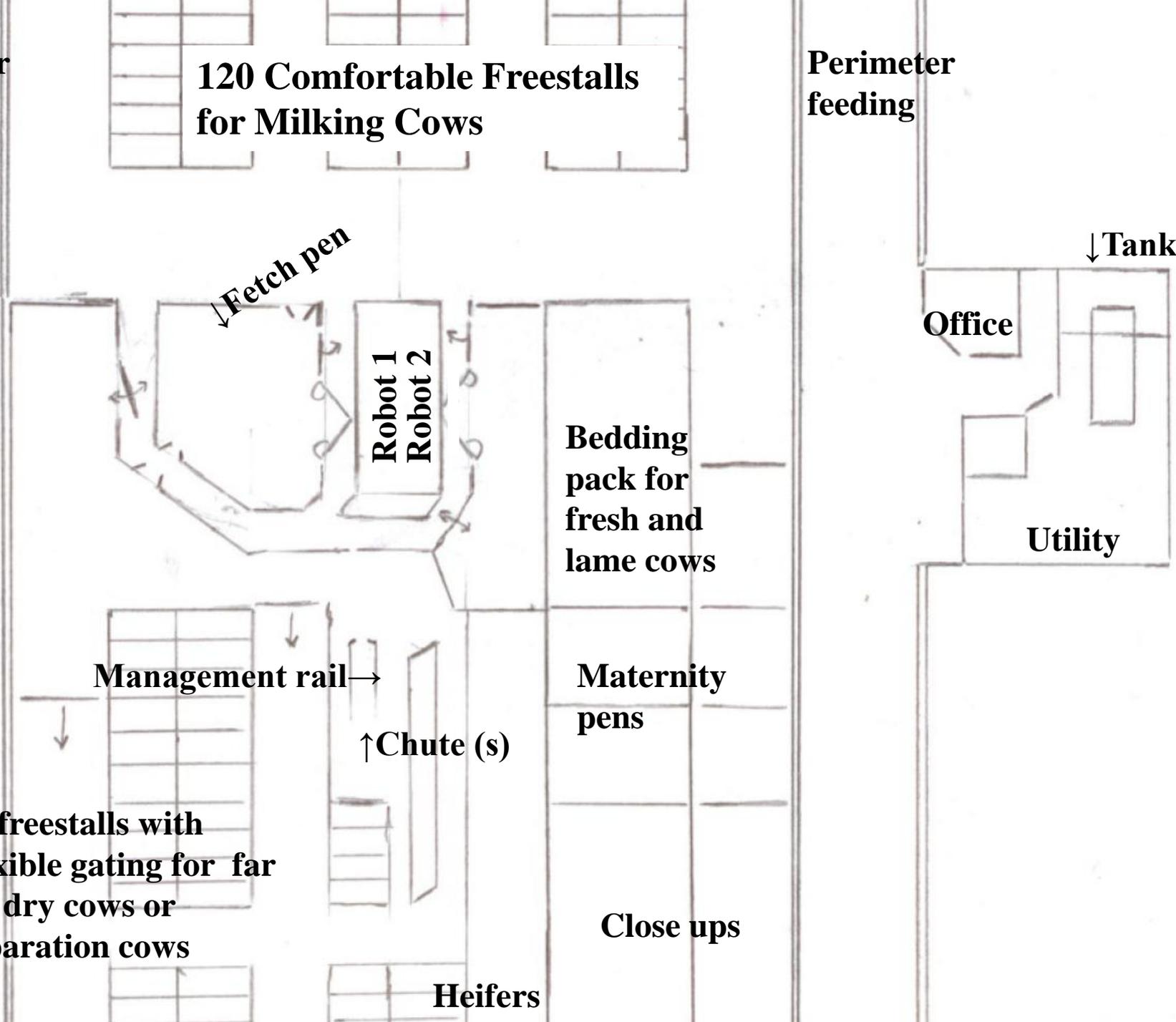
**↑ Chute (s)**

**Maternity  
pens**

**30 freestalls with  
flexible gating for far  
off dry cows or  
separation cows**

**Close ups**

**Heifers**



# How would I do forced traffic ???

The goal is to minimize waiting in the commitment pen, and avoid line ups at selection gates.

- Feed first vs rest first is farmers choice
- Four row tail to tail layout with perimeter feeding
- At least two selection gates and a pre-selection gate per group
- At least three wide one way gates
- Lots of open space around gates
- One robot and 60 cows or 2 with 120 max
- Option to leave the commitment pen back to the original side
- Provide a priority lane for timid cows
- Feed and/or push up feed frequently

# How would I do tandem multibox ???

The goal is to minimize waiting in the commitment pen, and avoid line ups at selection gates.

- With no experience and very few examples to learn from specific recommendations are difficult
- The first Ontario installation at Kie Farms has a very well thought out design for routing cows from one resting area to two separate manger areas, a separation pen and a special needs area.

# A Word of Advice

Robotic milking systems operating below capacity result in totally different dynamics in the herd. Never assume that what works well with 40 cows per box will work equally well with 60 or 70!

While the capacity expressed in cows, liters, or milking minutes will likely go up over time, experience is demonstrating that higher production per cow and lower labour input may favour fewer cows per box

The End .....

“Focus on cow comfort, and  
convenient handling !”



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Thank You !