1:1 Compact serpentine race for beef abattoirs

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Introduction

Cattle move more easily through a curved race with the handler working along the inner radius, compared to a straight race. (Grandin, 1980). A straight race is inefficient because the cattle balk and tend to back up in the race. There are two reasons why a curved race works more efficiently. First of all, the cattle can not see the stunning pen or restrainer until they are part way up the race. Secondly, a curved race with the handler working along the inner radius takes advantage of the natural tendency of cattle to circle around a person. (Grandin, 1980). When a person enters a pen of cattle, the animals will turn and face him. A curved race takes advantage of this natural behavior.

A well designed system with a curved race and a well planned lairage will usually reduce labor requirements. Stress on the cattle is also reduced because the animals move easily and are less likely to become excited. Observations in over 25 beef abattoirs with slaughter speeds ranging from 60 to 300 cattle per hour indicated that a curved race ususally required fewer people to move the cattle, compared to a straight race. A straight race usually required at least one additional person, to remove cattle from the lairage pens, and drive them into the stunning pen or restrainer conveyor.

Typical personnel requirements at a slaughter speed of 150 cattle per hour is three people to remove cattle from the lairage pens and drive them into the stunning pen. A well designed curved race system will usually enable two people to do the same job at this speed. In a well designed curved race system one person was able to easily drive 80 cattle per hour out of the lairage pens and into the stunning pen. In an Australian abattoir with a curved race and long narrow diagonal pens one person was able to drive and wash 70 cattle per hour. The design of the layout is described in Grandin, (1977 and 1981). The person driving the cattle in the curved race system described above, was able to move the cattle easily with a minimum of excitement. He did not have to run or move faster than walking speed to keep the slaughter line supplied with cattle.

Previously, the recommended inside radius for a curved single file race was 5m (McFarlane, 1976) to 3.5m (Grandin, 1980). When a curved race is constructed in an area with abundant space these recommendatons should be used. When an abattoir is being remodelled space is often limited. Races with a 3.5m to 5m radius are too large to fit inside the buildings in many abattoirs.

Materials and Methods

Observations were conducted to determine if a shorter inside radius would work, and to collect ideas for the design of efficient cattle handling systems for use in areas where space is limited. In four abattoirs in Canada and the United States races were being used that had curves with an inside radius which varied from 1m to 2m. Cattle were able to move easily through the races with a 1.5m to 2m inside radius. Large Holstein cows sometimes had difficulty moving through the race with the 1m inside radius. These four abattoirs slaughtered 450kg to 500kg grain fattened beef cattle, grass fed cattle and cull dairy cows. The breeds were Holstein, Angus, Hereford and crossbreds of these breeds with Charolais, Simmental, and other European breeds which are commonly used in the U.S.

Results and Discussion

Knowledge gained from the observations was used to construct a compact serpentine race in a beef abattoir which was remodelled to increase its slaughter line speed to 150 cattle per hour. The serpentine has the advantages of a curved race but it requires less floor space. (Figs. 1,2,3,4, 5). The serpentine design makes it possible to provide sufficient race length to encourage following behavior and maintain a continuous cattle flow in a small space. The serpentine design can be used for either an elevated ramp or a race at floor level. Two people can easily drive 150 cattle per hour in a continuous flow into the conveyor restrainer for stunning. The people remove the cattle from the lairage pens and drive them into the restrainer for stunning. They receive no assistance from the stunner operator. The handlers were able to easily maintain this rate and they did not move faster than walking speed. This system can handle a variety of cattle types. The abattoir using the serpentine race slaughters the same types of cattle that are described in the introduction.

The system has two 180 degree curves with a 1.5m inside a radius. The race has solid sides spaced 81cm apart and constructed in a smooth continuous curve. The race must NOT be constructed in a series of straight sections. Cattle move rapidly through the serpentine. Downed cattle can be easily pulled out after they are stunned. The first 3m to 4m of single file race where it joins onto the crowd pen must be relatively straight prior to the first curve with a 1.5m radius. Balking may occur if a curve with a 1.5m inside radius starts at the junction between the single file race and the crowd pen.

Since the race is laid out in a serpentine design, the handlers sometimes have to work from the outer radius instead of the preferred inner radius. The handlers should station themselves at positions 1, 2 and 3 on Figure 1 and remain along the inner radius as much as possible, moving to the outer radius only to push the crowd pen gate or move balky cattle.

Figure 6 illustrates an idea for a spiral ramp to an elevated restrainer conveyor that circles over itself like the ramp in a parking garage. The advantage of this layout is that the handler would always be working from the preferred inner radius. The diagonal pen layout in Figure 6 eliminates sharp corners and provides oneway traffic flow. The entire system will fit inside a rectangular building. The serpentine chute in Figure 1 also can be used with the crowd pen and stockyard layout in Figure 2.

Crowd Pen and Storage Lane

In abattoirs slaughtering over 100 head per hour a storage lane is essential. Cattle are often difficult to drive out of the lairage pens and directly into the crowd pen. The storage lane should hold a minimum of two crowd pen loads of cattle, preferably more. A storage lane which holds two crowd pen loads of cattle will also make handling more efficient in smaller plants. Cattle will be moved most efficiently into the crowd pen in 15 to 18 head groups.

To reduce bunching at the junction between the single file race and the crowd pen, one side of the crowd pen should be straight and the other side should be on a 30 degree angle (Grandin, 1981). Never build a crowd pen on a round. The cattle will pile up against the crowd gate. The crowd pen floor should level except for a slight drainage slope. The ramp should be in the single file race.

Design of Races

The race should be 81 cm wide for grain fed steers, grain fed bulls and cows. The single file race, crowd pen and curved holding lane should all have 1.67m high fences. Cattle have wide angle panoramic vision (Prince, 1977). The solid fences prevent them from seeing people and other distractions on the other side of the fence. The crowd gate should also be solid to prevent the cattle from turning back towards the lairage (Rider et al, 1974).

The sides of the race should be solid, but the animals must always be able to see a pathway of escape. Sliding gates and oneway gates should be constructed so that cattle can see through them. Cattle will balk if the race appears to be a dead end. To prevent the animals from being frightened, the tailgate of the stunning pen should be solid.

Cattle will often refuse to approach visible people. Shields for handlers to stand behind are recommended (Grandin, 1981) (Kilgour, 1971). In areas with a solid fence, mangates must be irstalled to enable handlers to get out of the way of cattle. The best mangate design is a 46cm wide metal door that opens inward towards the cattle. It is held shut with a spring and there is no latch. Walkways for the handlers should run along side the races and must be head. The recommended dimension is 100cm from the top of the fence to the walkway platform.

The inside of the race should be smooth to prevent bruises. An object with a small diameter such as the edge of an angle iron is most likely to bruise. Stunned cattle can still be bruised (Meischke and Horder, 1976). To prevent slipping, ramps should be constructed with stair steps. The recommended minimum dimensions are a 10cm rise and a 30cm tread. A more gradual ramp should be constructed with 10cm by 60cm steps if space permits.

General Recommendations

Cattle tend to move from a dimly illuminated area to a more brightly illuminated area, provided that the light is not glaring in their eyes. Lamps are used to attract cattle into races and to make them hold their heads up for stunning.

Cattle will often refuse to cross a drain grate or shadow. In new facilities drains should be placed outside the areas where cattle will walk. It is sometimes difficult to persuade cattle to enter a building from outside. To facilitate the movement of cattle into a building, the building wall must NEVER be placed at the junction between the single file race and the crowd pen. If the crowd pen is outside, the single file race should extend at least 3m beyond the wall. The cattle will enter more easily if they are lined up in single file before they enter the darker building. The other alternative is to construct a building over both the crowd pen and the race. Even if the lairage is totally enclosed an interior wall must NEVER be placed at the junction between the crowd pen and the single file race.

Conclusions

A serpentine race with a 1.5m radius curves will provide the advantages of a curved single file race in a smaller floor area. This design is recommended for use in abattoirs where space is limited.

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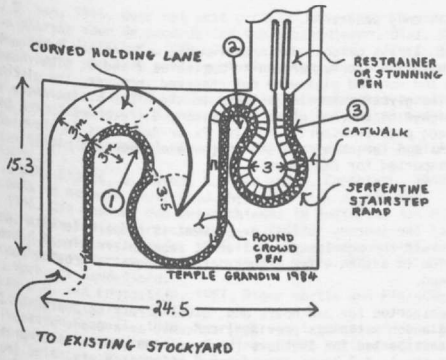

Figure 1. Serpentine race system provides the advantages of a curved race system but it fits in a much smaller space. The handlers should remain in positions 1,2,3 as much as possible to take advantage of the natural tendency of cattle to circle around people.

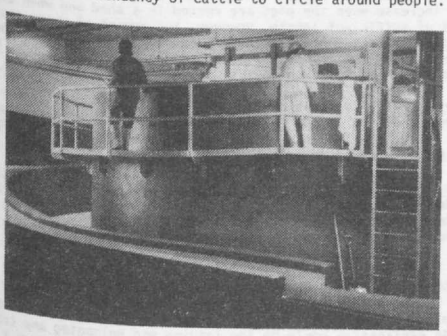

Figure 2. Overall view of the serpentine race system. The barrel-like structure is the curved ramp leading up to the conveyor restrainer which is elevated above the lairage.

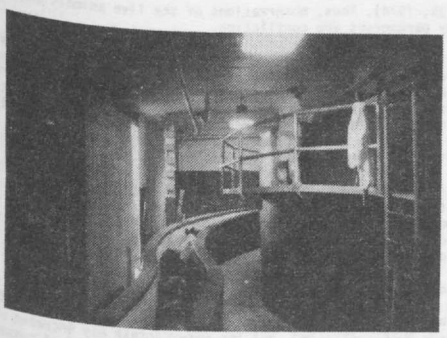

Figure 3. The first 3 to 4m of the race must be relatively straight before the first curve with a 1.5m radius.

Figure 4. Handler working the inside radius. He is in position 2 on Figure 1.

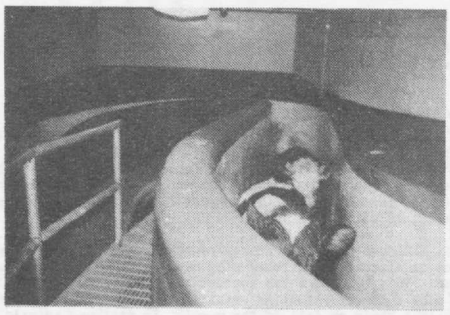

Figure 5. Cattle walking up the serpentine. The race sides are solid and they are constructed in a smooth continuous curve.

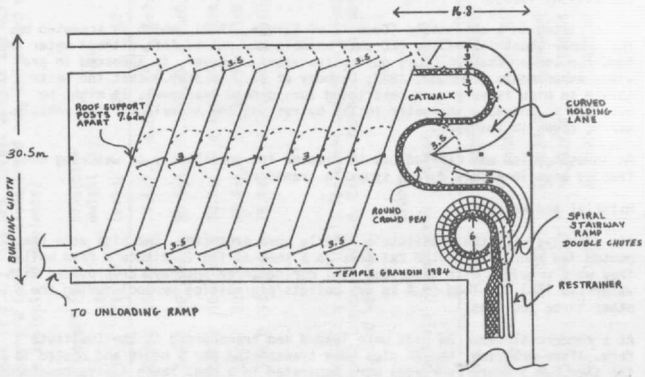

Figure 6. Idea for a spiral stairway ramp which circles over itself like a parking garage ramp. The entire system would fit in a rectangular building. The diagonal pen layout can also be used with Figure 1.