Review of the Mark I, II and III cattle restraining boxes

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Abstract

Restraining animals for slaughter is an unavoidable procedure. The restraint methods used have implications for animal welfare, carcass and meat quality, processing efficiency and safety of the stockman. Traditional methods of restraint used for local cattle in the Middle East and Southeast Asia usually involve manual handling and the use of halters. However, these methods have not always been effective for imported Australian cattle, unfamiliar with human contact and handling procedures. Consequently, there has been a tendency to use inhumane, unacceptable methods of restraint in an attempt to cast the animal whilst avoiding injury to the stockman. Since 2000, three designs of restraining box have been developed (Mark I, II and III), to replace these methods and improve the casting and restraint process. The aim of this review is to:

- Review the design of each of the three cattle restraining boxes and complete a comprehensive desktop assessment of the animal welfare and occupational health and safety impacts of each of the designs.
- Provide details on the welfare benefits that a correctly functioning Mark I cattle restraining box has compared to traditional slaughter methods of cattle in SE Asia.
- Detail potential modifications that may be required to further improve animal welfare aspects of each of the three cattle restraining boxes.

The future development of restraining boxes will improve processing efficiency and safety and enable the humane handling and effective slaughter of cattle. This will have a long term benefit to the industry by encouraging the demand for Australian cattle, whilst improving standards of animal welfare throughout the export chain.

Executive summary

The restraint methods used for cattle have implications for animal welfare, carcass and meat quality, processing efficiency and safety of the stockman. Traditional methods of restraint used for local cattle in the Middle East and Southeast Asia have involved manual handling and casting procedures. However, these methods are not always effective for imported Australian cattle, unfamiliar with human contact. Consequently, there has been a tendency to use inhumane, unacceptable methods of restraint in an attempt to cast the animal whilst avoiding injury to the stockman. Previous research has identified the current casting and restraint processes as key welfare issues and since 2000, three designs of restraining box have been developed (Mark I, II and III), to replace these methods.

The aim of this review was to:

- Review the design of each of the three cattle restraining boxes and complete a comprehensive desktop assessment of the animal welfare and occupational health and safety impacts of each of the designs.
- Provide details on the welfare benefits that a correctly functioning Mark I cattle restraining box has compared to traditional slaughter methods of cattle in SE Asia.
- Detail potential modifications that may be required to further improve animal welfare aspects of each of the three cattle restraining boxes.

To fulfil the aims of the review, the author observed and assessed:

- Traditional methods of cattle handling, restraint and slaughter in Southeast Asia and the Middle East.
- The use of the Mark I restraining box (both the preliminary design and the updated model).
- A short video clip showing the use of the Mark II restraining box.
- Design plans for the Mark II and III restraining boxes.

The main conclusions from the review were that the use of restraining boxes in the Middle East and Southeast Asia has the following benefits:

- Improved animal handling pre-slaughter and during the slaughter process as it removes the need to incapacitate cattle in an attempt to restrain them effectively.
- Increased processing efficiency and improved safety.
- Demonstrated commitment to improving animal welfare standards in the export chain.

Future developments in the design of the restraining boxes need to take into consideration the following observations:

- The success of the restraint system is dependent upon the interaction between the stockman, animal and the environment. This can form the basis of a practical welfare assessment of the whole process.
- More sophisticated technology is less likely to be adopted if it does not satisfy production requirements (even if there is a demonstrated welfare advantage).
- New technology requires support from knowledgeable and skilled stockmen. The overall acceptance of the restraining box may be reduced if it involves complicated installation, operation and maintenance processes.

Contents

1 Background

1.1 The introduction of cattle restraining boxes

Prior to export, many Australian cattle have had little human contact and handling, and therefore during slaughter the introduction of appropriate methods of handling and restraint is required to protect both animal welfare and the safety of the stockman.

In the past, unacceptable methods such as eye gouging, tendon cutting and hoisting live animals have been used by stockmen in an attempt to safely restrain imported cattle. These practices (stated to cause severe pain and stress by the OIE Terrestrial Animal Health Code 2008) were used along with manual casting as no other methods were readily available.

The live export industry identified this as an area which required future investments and improvement. Consequently, in the last 10 years there have been a number of significant developments to improve animal welfare during the handling, restraint and slaughter processes:

- In 2000, the first cattle restraining box (Mark I) was designed and built. By 2001, four boxes of this type had been installed in Indonesian slaughter facilities.
- During 2002, five Mark I restraining boxes were installed in Malaysia, Indonesia, Middle East and Brunei.
- The Mark I box was redesigned in 2003 and a new prototype (Mark II) was developed.
- There were twenty-seven Mark I boxes (including replicas and revised boxes) and one prototype Mark II box installed by 2004.
- The Mark II restraining box was successfully tested in June 2004 (LIVE.309 - Final report on cattle pre-slaughter restraint box).
- From April 2006, the restraining box program has received Australian government funding under its Keniry animal welfare assistance program. At that time, the APFINDO (Indonesian Feedlotters Association) Animal Welfare Taskforce was formed to work in conjunction with MLA/Livecorp to identify sites and manage the installation of restraining boxes.
- Between April 2006 and December 2007, 50 Mark 1 restraining boxes were installed in slaughterhouses across Java and Sumatra. The sites were identified based on a survey and advice from the members of APFINDO who, in turn, have consulted with their customers to ensure sites of high priority have been selected.
- Between January 2008 and 30 June 2009 a further 46 Mark I boxes were installed.
- As of 30 June 2009 there are a total of 96 Mark I restraining boxes installed and an estimated 20 to 40 other boxes also being used.
- In July 2009, a new counter-levered Mark II box was installed at Cibinong Abattoir, Bogor, Indonesia. It is now undergoing testing before further installations are made.
- The Mark III restraining box is currently a design concept and awaiting manufacture.

The World Organisation for Animal Health (OIE) has developed a set of normative documents for member countries, designed to improve the welfare of animals through a science-based approach. One such document is the Terrestrial Animal Health Code 2008, which includes a requirement to minimise avoidable pain and suffering at every stage of the pre-slaughter and slaughter processes until the death of the animal. The development of the code involved a study of specific issues associated with slaughter without stunning, acknowledging religious and cultural requirements. The OIE concluded that the process of slaughter without stunning should not be exempt from the guidelines and consequently methods of restraint have to comply with several basic requirements, as detailed below:

- Provision of a non-slip floor.
- Ensuring that the restraining equipment does not exert excessive pressure, thus causing the animal to struggle or vocalise.
- Engineering equipment to reduce the noise of hissing air and clanging metal.
- Ensuring equipment has no sharp edges that would harm animals.
- Using restraining devices appropriately and not jerking them or making sudden movements.

The installation of a restraining box will only achieve all the desired outcomes of the OIE code if it is operated by a knowledgeable and skilful stockman and maintained to ensure that acceptable standards of animal welfare are consistently achieved.

2 Project objectives

The objectives of the review are:

- **Objective 01** - Provide details on the welfare benefits that a correctly functioning Mark I cattle restraining box has compared to traditional slaughter methods of cattle in SE Asia.

- **Objective 02** - Assess the welfare implications associated with the use of each restraining box and provide a series of recommendations for further development and potential modifications.

3 Methodology

3.1 General assessment methodology

To fulfil the objectives of the review, the author used the following methodology:

- Observed the use of traditional methods to handle, restrain and slaughter cattle.
- Observed the use of the Mark I restraining box (both the preliminary design and the updated model).
- Reviewed a short video clip showing the use of the Mark II restraining box and studied the design plans.
- Reviewed the design plans for the Mark III restraining box.

The use of traditional methods to handle and restrain cattle, and the associated impact on animal welfare, is described in Section 4. This Section also contains a brief outline of the theory relating overall animal welfare outcomes to the interaction between the stockman, environment and the behaviour of the animal. Section 3.2 provides a short description of the features and operation of each restraining box. Each box was assessed against the following criteria and the results are presented in a summary table in Section 4.2.

- Impact on animal welfare
    - Time spent restrained
    - Time between casting and slaughter
    - Avoidance of unnecessary fear, pain and distress
    - Ease of the casting process
- Impact on product quality, processing efficiency and safety of the stockmen.
- Acceptance by the industry and sustainability.
- Compliance with World Organisation of Animal Health (OIE) standards and codes of practice (detailed in Section 1.1).
- Potential for future development.

The conclusions and recommendations for the further development of the Mark II and III restraining boxes are based on the analysis of the design plans and the operation details, with a consideration for the basic principles of animal welfare and operator safety. It is essential that a full practical assessment of the prototype boxes is performed in the future, before commercial construction and installation.

3.2 Features and operation of the Mark I, II and III cattle restraining boxes

3.2.1 Common purpose of each restraining box

The purpose of each restraining box is to replace manual casting (and inhumane methods of restraint) and to position the animal for slaughter. Therefore, the ultimate welfare outcome for each box is:

- Effective casting, avoiding unnecessary pain and distress
- Correct positioning of the head and neck to enable quick and effective slaughter

The processes used to achieve the stated outcomes are different for each restraining box design (as described in Sections 3.2.2 - 3.2.4).

3.2.2 Mark I restraining box

The use of the Mark I restraining box (Figure 01), is an attempt to manipulate the natural escape behaviour of each animal in the casting and restraint process.

Figure 01 Mark I restraining boxes showing lower plinth height (left figure) and modified box with raised plinth (right figure)

Summary of the casting and restraint process using the Mark I restraining box:

- The restraint box is designed to enable casting of the animal, brought about by its exit through the side door, once the catch has been manually released by the stockman. Ropes are attached to two legs prior to door release.
- The length of the front rope arrests forward movement of the leg and the momentum of the animal initiates a roll out towards the slope of the plinth. The animal is restrained by a combination of its own weight on the sloping plinth and the tension on the casting rope.
- Following casting, a rope is usually placed around the head, neck and horns, or the head is manually restrained by the stockman. Downward pressure by the stockman prevents any attempt by the animal to regain posture.

3.2.3 Mark II restraining box

The Mark II restraining box was developed to control the actual casting process to a greater degree, by the addition of an 'L' shaped side wall and counter weight, which lowers cattle into position. Initial visual assessments of the use of the prototype concluded that the casting process was improved when compared to the use of the Mark I restraining box (LIVE.309 - Final report on cattle pre-slaughter restraint box).

Figure 02 Mark II restraining box showing side wall in its final resting position (right figure)

Summary of the casting and restraint process using the Mark II restraining box:

- On release of the catch, the weight of the animal propels the side wall until it comes to rest below the horizontal.
- The animal is restrained by a combination of its own weight on the sloping side wall and the tension on the casting ropes.
- The metal side wall constitutes the platform for slaughter. It replaces the concrete plinth used with the Mark 1 restraining box.
- Downward pressure by the stockman prevents any attempt by the animal to regain posture.

Use of a foot catching device

A foot catching device has been developed to replace the casting ropes when the Mark II restraining box is used. The aim of the foot catcher is to allow the stockman to attach a plastic restraining ring around the leg of the animal from the rear of the restraining box, thus avoiding potential injury associated with the placement of conventional casting ropes. The device has been trialled in the field, though welfare implications, effectiveness and durability have yet to be proven. There is a concern that the rigidity of the foot catcher may cause increased pressure on the leg of the animal, potentially resulting in more discomfort than the use of conventional ropes. However, without scientific evidence, it is difficult to recommend the use of one method over the other. Overall it is likely that the use of the foot catcher will improve animal welfare during restraint as it significantly reduces the amount of time that the animals are held in the restraining box and improves the speed of casting and slaughter.

3.2.4 Mark III restraining box

The Mark III restraining box is currently a design concept. It is relatively similar in construction and function to the Mark II box, with the added feature of a squeeze function to aid casting of the animal.

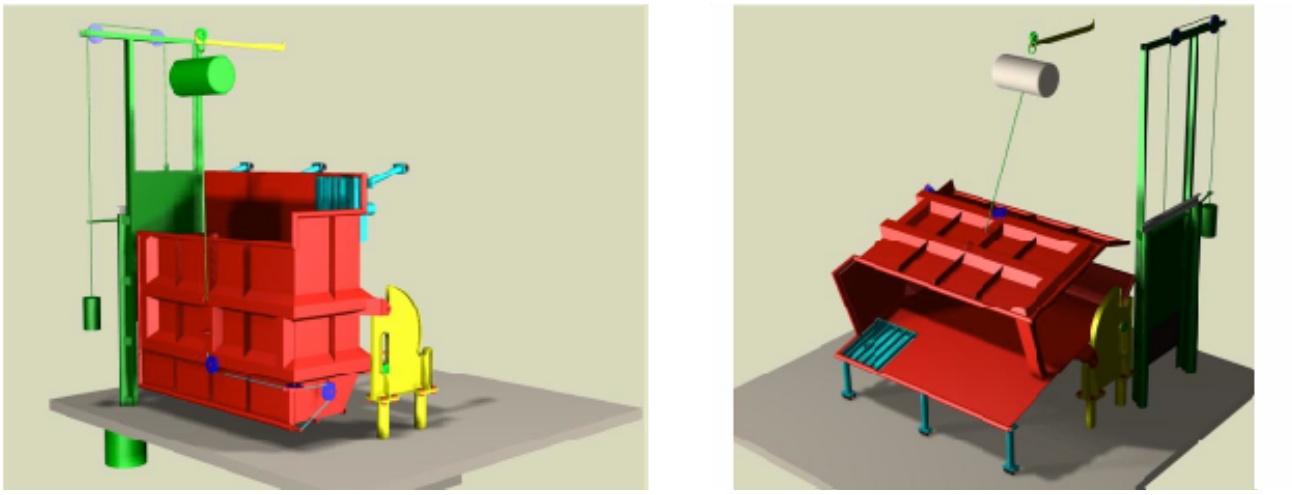

Figure 03 Mark III restraining box showing tipping action and the final resting position (right figure)

Summary of the casting and restraint process using the Mark III restraining box:

- Unique to the Mark III restraining box is the ability to raise cattle off the floor as part of the casting process. This is achieved by raising the two side walls using an electric hoist, which lifts and holds cattle 150mm above the floor of the box.
- On release of the catch, the weight of the animal propels the box until it comes to rest below the horizontal.
- The animal is restrained by a combination of its own weight and the tension on the leg restraint.
- The metal side wall constitutes the platform for slaughter. It replaces the concrete plinth used with the Mark I restraining box.
- Downward pressure by the stockman prevents any attempt by the animal to regain posture.

4 Results and discussion

4.1 Objective 01

4.1.1 Comparison of traditional animal handling and the use of a restraining box

Traditional methods of handling and casting (Figure 04) are more successful when they involve manipulation of the natural behaviour of the animal. Coercion, such as pushing and pulling induces levels of stress and can make the whole process more difficult for the stockman. Cattle are usually led to the slaughter area using a halter or rope, which is then tied to a post, ring or rail. The rope is used to lower the animal's head to the floor and the stockmen push the hind quarters to one side causing the animal to fall. Additional ropes are sometimes attached to the legs to aid positioning for slaughter. Often, the floor surface is very smooth and cattle tend to slip, resulting in a fall to the ground with little or no coercion from the stockman.

Once the animal is positioned on its side, ropes are used to bind the legs and sometimes the head. This procedure has no real benefit in terms of animal handling and manipulation and may actually increase levels of fear, stress and injury. After casting, the rope used to fasten the head in position is loosened to allow orientation of the animal for Halal slaughter. The position of the rope on the neck can restrict blood flow from the sticking wound, contributing to an increased time to brain death.

With appropriate skill and knowledge, the traditional handling methods can be performed without inducing high levels of stress in cattle. However, the use of a restraining box allows for improved consistency in the process and provides a solution for imported Australian cattle which can be difficult to handle in the traditional way. The use of the restraining boxes utilises the positive animal handling concepts of traditional methods, whilst introducing more control to the actual casting and restraint procedures.

Figure 04 Traditional manual handling and casting of local cattle in Indonesia

4.1.2 Stockmanship and the abattoir environment

Successful restraint is an interaction between the equipment used, the stockman and the behaviour of the animal. The design and operation of the cattle restraining boxes is a small part of the overall handling, casting and slaughter process. The skill and experience of the stockmen is essential regardless of the equipment that is used.

The movement of the animal from the holding area into the restraining box is likely to be similar for all three designs. The welfare of the animal at this point is dependent on a combination of factors involving the abattoir environment, the action of the stockman and the response of the animal. The overall welfare outcome is therefore controlled through the introduction of effective procedures and supported by skilled and adequately trained personnel. Table 01 illustrates areas that require control to enable the best welfare outcome. This can be applied when any of the three restraining boxes are used.

Factors inhibiting movement	Example of corrective action
Entrance too dark	Indirect lighting in the approach race and restraining box
Exposure to stressors in the holding area	Quiet holding area and reduction in known stressors
Angle of entry ramp	Gently sloping ramp constructed from non-slip material
'Dead end' in box	Adequate lighting, aperture in the end wall
Presence of stockmen causes baulking	Awareness of flight zone and relative position of the stockmen
Excessive noise	Rubber dampers on equipment, reduction of noise in processing area
Objects causing baulking	Removal of all loose ropes, plastic etc
Changes in surface texture	Consistency in floor texture from the race to the restraining box where possible

Table 01 Factors influencing the movement of cattle into the restraining box (common for all three restraining box designs)

Predisposing animals to high levels of stress prior to restraint, through poor handling and facilities will have an effect on the ability to use the restraining box effectively. The same design of box in different abattoirs (with unique environmental attributes) may vary in the success of operation. There will be variations in the restraint process due to the individual carrying out the procedure. The introduction of training and guidance will help to introduce consistency into the process.

4.2 Objective 02

The following section provides a summary of the potential welfare, health and safety and processing issues associated with each restraining box. It was apparent that the Mark II and Mark III restraining boxes have very similar attributes that solve some of the issues associated with the Mark I restraining box. However, it needs to be recognised that the Mark I restraining box is an extremely valuable addition to a traditional cattle handling system and they do not necessarily require replacement by the later models. Sections 4.2.1 and 7.2 provide a list of recommendations that can be used to improve the welfare outcomes associated with the use of a Mark I box.

4.2.1 Summary of the key welfare outcomes

Welfare outcomes * Requirement of the OIE Terrestrial Animal Health Code 2008	**Restraining Box**			**Comments**
	Mk I	**Mk II**	**Mk III**	
Contains non-slip flooring*	✓	✓	✓	The restraining box floor needs to provide good foot grip, particularly the Mark II and Mark III boxes, where it is essential that the animal remains standing prior to casting. All new boxes (Mark I, II and III design) are manufactured with non-slip flooring.
Manufactured to avoid sharp edges that could injure livestock*	✓	✓	✓	
Fitted without the requirement for a raised entry ramp	×	✓	✓	The raised concrete plinth used with the Mark I restraining box means that a sloping entry ramp is required.
Controls casting process	×	✓	✓	The main welfare concern associated with the Mark I restraining box is the occasional severity with which the animals fall onto their side on the concrete plinth. Possible repeated attempts to regain posture can cause the animal to impact its head and body against the hard surface. The design of the Mark II and Mark III boxes will alleviate this problem and control the casting procedure to a greater degree. In some abattoirs that have the Mark I restraining box installed, a tyre has been used to act as a buffer to reduce the impact of the animal's head with the concrete plinth (LIVE.309 - Final report on cattle pre-slaughter restraint box).
Allows the next animal to be moved into the box	✓	×	×	Moving the next animal into the box may actually increase the time of restraint so is therefore not a necessarily desirable feature.
Restraint avoids compression of the animal*	✓	✓	×	Although the Mark III box uses squeeze sides to lift and cast the animal, this can be effectively controlled to avoid compression to the thorax and abdomen (see Section 7).
Solid sides prevent animal from baulking at stockman in flight zone	×	✓	✓	When the Mark II and III restraining boxes are used, the animal is held within the confines of the restraining box until casting occurs and is not affected by the presence of the stockman on the slaughter floor.
Consistently positions animal in correct position for slaughter	×	✓	✓	The Mark I restraining box involves more manual handling than the Mark II and III restraining boxes. Once the animal has exited through the side door, the casting process becomes less controlled and there will be variations in the final position of the animal.
Current design allows for mechanical stunning in the future	✓	×	×	To facilitate mechanical stunning, the design of the Mark II and III boxes would need to be adapted to allow for the collapse of the animal following effective stunning.
Low noise*	×	✓	✓	When the Mark I box is used, the attachment of the casting ropes to the hind legs can initiate in a severe kicking response, usually aimed at the entry door, resulting in a loud banging noise. This may increase stress levels not only in the restrained animals but also those waiting for slaughter. The use of a foot catcher (as described in section 3.2.3) in place of the ropes (when using the Mark II and III boxes) may improve the effectiveness and aesthetic acceptability of the capture process.
Does not require the animal's head to be restrained	×	✓	✓	The use of a restraining bar on the Mark I restraining box may have a negative impact on animal welfare by increasing the time between casting and slaughter.

4.2.2 Summary of the key operator safety and processing outcomes

Operator safety and processing outcomes	Restraining Box			Comments
	Mk I	Mk II	Mk III	
Aperture for blood collection or disposal that does not require animal to be restrained	×	✓	✓	The original Mark I plinth (Figure 01- Left) was not designed to facilitate restraint or blood collection. The higher plinth on subsequent Mark I models incorporates a restraining bar and allows slaughtermen to stand more upright during slaughter and bleeding. The Mark II and III restraining boxes allow blood collection through an aperture in the side wall, without the need to tie the animal's head.
Improved protection for stockmen	×	✓	✓	The casting process is an integral part of the box design (Mark II and III), whereas manual the manual casting associated with the Mark I box may pose a potential risk to the safety of the stockman.
Increased ease of operation (with appropriate training)	×	✓	✓	The process of capturing the cattle and initiating the lifting procedure, with the Mark III restraining box, relies on the skill of the slaughterman, who has to make the decision whether the animal is in a suitable position for casting. This may be more complex than the operation of the Mark II box. The Mark I box is can be variable in its ease of operation due to the reliance on manual casting.
Design allows the use of a modified foot catcher	×	✓	✓	The current design of the Mark I box does not allow for the use of the foot catching device.
Reduces carcass damage	×	✓	✓	Head bruising is reduced with Mark II and III designs.
Does not require power for operation	✓	✓	×	The design plans for the Mark III restraining box indicate that the squeeze sides are operated electronically. This needs to be validated.

5 Success in achieving objectives

All objectives of the review have been achieved; however it is essential that the Mark II restraining box undergoes a commercial trial to ensure that it satisfies animal welfare, safety and processing requirements in practice. The prototype Mark III box requires assessment prior to commercial introduction.

6 Impact on meat and livestock industry

The introduction of the restraining boxes to replace current handling methods will have an immediate impact on animal welfare standards. It will help to alleviate some of the consumer concerns related to the live export trade and demonstrate a commitment to improving animal welfare throughout the export chain. The use of cattle restraining boxes will benefit the local industry by improvements to efficiency and carcass quality. When supported by training and guidance, it will also ensure a safer working environment for the stockman.

7 Conclusions and recommendations

7.1 Conclusions

The use of a restraining box (Mark I, II or III) improves the aesthetics of the casting process and is likely to improve animal welfare. The actual impact on animal welfare requires scientific validation through practical assessment in a commercial environment. All three designs of restraining box can work well when operated by skilful stockmen. Although, it is actually the operation of the most simple design (Mark I restraining box) that potentially demands a higher degree of skill and stockmanship to ensure a good welfare outcome. The Mark I box represents a simple addition to the process that can improve animal welfare, though there may be some variation in the acceptability of the casting process due to the fact that it is relatively uncontrolled once the animal leaves the box. The Mark II and III restraining boxes control the process to a greater extent, though do not replace the requirement for skilled stockmen. The Mark II and III boxes may also have higher maintenance requirements due to the addition of more moving parts. Abattoirs within Indonesia have already copied and installed their own boxes which may demonstrate that they have started to recognise the processing and safety improvements associated with the use of a restraining box compared to traditional slaughter. The selection of a particular restraining box design (Mark I, II or III) needs to be carried out on an individual abattoir basis, taking in account the key outcomes for each design (Section 4) along with the processing requirements and existing infrastructure of the facility itself. This will not only ensure that welfare outcomes are achieved, but will produce a positive change in the behaviour of stockmen, making their job both easier and safer, and encouraging continued use of the retraining box.

Future development of restraining box design requires careful consideration to protect animal welfare. If the Mark III restraining box is developed further then it is essential that the lifting and casting process is performed quickly and smoothly. There have been few studies on the use of this exact type of restraint and casting technology, though the technique can be compared to that of squeeze chutes and hoof-trimming crushes, which are used successfully throughout the livestock industry. However, it is worthy of note that full inversion of cattle (as observed with the Weinberg rotary pen) has been shown to increase stress indicators (increase in cortisol and haemocrit values) compared to cattle that remain standing in an upright pen (Dunn, 1990). It is imperative that any future developments of the Mark III restraining pen do not encompass full animal inversion as this has serious animal welfare implications.

7.2 Recommendations for further development and potential modifications

The recommendations detailed below need to be considered in conjunction with the positive features and attributes of each restraining box listed in Section 4.2:

7.2.1 Recommendations for the development of the Mark I restraining box

- The raised entry ramp in the Mark I box needs to be non-slip.
- The restraining boxes need to be lit to encourage cattle movement.
- Some cattle will manage to get their head through the gap between the side of the restraining box and the floor. Horned animals may become trapped which increases stress levels and the likeliness of injury during restraint and casting. This needs to be prevented through changes in the dimensions of future Mark I restraining boxes.

7.2.2 Recommendations for the development of the Mark II restraining box

- Any escape behaviour or attempted righting of the head following casting may have the effect of altering the centre of gravity of the animal on the side wall. This may cause movement of the platform rather than allowing it to settle in its final resting position. The mechanism must ensure that the platform remains stable.
- The prototype uses torsion springs to operate the side wall. Future boxes will involve the use of a concrete counter balance, which will allow the box to function in a similar manner. This feature will require assessment in practice. After the transfer of the carcass to the beef dressing trolley, the closing mechanism for the side wall needs to be controlled to protect the safety of the stockmen.

7.2.3 Recommendations for the development of the Mark III restraining box

- There is a requirement for a mechanism to abort the lifting and casting process in the event of a mechanical issue or a problem with the position of the animal.
- The leg restraint equipment needs to accommodate the lifting action and rotation of the restraining box. The foot catching device requires further development and assessment.
- During the production of the prototype, the squeeze restraint mechanism requires careful development and testing to ensure the angle of restraint is correct and excessive pressure is not applied to the animal.

7.2.4 Industry recommendations to support the introduction of cattle restraining boxes

- There is a requirement to train stockmen in the operation of the restraining boxes and associated animal handling techniques.
- Continuing support is needed to ensure correct manufacture, installation, operation and maintenance of the restraining boxes.
- There is a requirement for independent assessment and process improvement to ensure effective and sustained use of the new systems.

8 Bibliography

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