



FEEDLOT DESIGN AND CONSTRUCTION

27. Truck weighbridges

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Weighbridge with good signage and a long sampling platform, allowing load to be inspected or sampled without repositioning the trailer.

Introduction

Lot feeding is a high turnover, low margin business requiring precision management. Incoming and outgoing cattle, feeds, commodities and by-products (such as manure or compost) must be weighed accurately and efficiently. Most medium and large feedlots have at least one onsite weighbridge for these purposes.

Design objectives

A weighbridge at a feedlot must be designed and constructed to

- Comply with national trade weighbridge legislative requirements.
- Minimise travel times between the weighbridge and the loading/unloading areas.
- Protect feedlot security and biosecurity.
- Provide accurate and timely weighing of vehicles.
- Weigh vehicles of all sizes likely to enter or leave the feedlot.
- Provide good access for rapid entry, weighing and exit.
- Provide a safe working environment.
- Drain quickly and completely following heavy rainfall.
- Provide a safe location and infrastructure to enable feed commodity deliveries to be sampled for compliance with contracts.

Mandatory requirements

To ensure compliance with legislative requirements, weighbridge owners, operators and installers need to be familiar with the current weighbridge regulations from the National Measurement Institution (NMI). All trade weighbridges must comply with the National Measurement Act (1960) and the National Trade Measurement Regulations (2009) (Cth) (NTMR) - and the 1 July 2011 amendment.

If the weighbridge is used for trade, it must be pattern (design/type) approved and then tested by a verifier in accordance with the requirements in National Instrument Test Procedures (NITP) 6.1-6.4, which cover non-automatic weighing instruments. The weighbridge is 'used for trade' if it is 'used, or made available for others to use, to buy or sell goods to determine freight costs or other charges based on weight or to determine a tax'.



A level, concrete, weighbridge approach as required by NMI regulations.

Design choices

Weighbridge location

The weighbridge should be situated beside the main feedlot office, or linked to it with communications and security cameras (see *Section 2 - Feedlot site layout*). It should preferably be close to the main entrance to the feedlot. It should be located away from the cattle pens to protect the biosecurity of cattle on feed. The site must allow for the easy and safe sampling of incoming commodities, so there should be clearance from other vehicle movements. Any vehicle using the weighbridge must be able to move on and off without the vehicle needing to turn on any part of the platform.

The weighbridge must provide the weighbridge operator with a clear view of each platform in its entirety and the measured weight at the same time, without the operator needing to move from their normal operating position.

Provision of accurate and reliable weighing of vehicles

To ensure accurate and reliable weighing of vehicles, the weighbridge needs to be properly situated, installed and maintained.

From the Weighbridge Operators Manual: A Guide for Operators who Conduct Public Weighings (National Measurement Institute 2013), the approach to the weighbridge must

- Have a hard, true and durable surface of concrete (or another approved material).
- Have a perimeter that is clearly marked from the surface by painted marks or other approved means.
- Be arranged so that drainage from the surface of the approach does not flow into the pit.
- Be in the same plane as the platform for a minimum distance of:
 - 3m if the length of the platform is less than 18m
 - 1m if the length of the platform is 19 metres or more.

The approach to a platform of a weighbridge that is at the entry or exit end of the entire weighbridge is in the same plane as the platform if

- For a weighbridge not used for end-to-end weighing, the entire surface of the approach is within +/- 2 degrees of level (horizontal) - measured from the end next to the platform.
- For a weighbridge used for end-to-end weighing, the approaches are within +/- 0.25 degrees of horizontal - measured from the end next to the weighbridge.
- For a multi-platform weighbridge, the dead space (if applicable) between the platforms of the weighbridge is level and in the same plane as each of the platforms.

Platform of the weighbridge

Each platform of a weighbridge must be composed of concrete and/or steel or another approved material.

For a multi-platform weighbridge

- The dead space between each platform must not exceed 2m.
- The operation of one platform should not affect the operation of any other platform.
- The upper surface of each platform should be on the same plane.
- A summing indicator must be installed.

A weighbridge with one or more pits must

- Cover each pit entrance.
- Provide free access to each part of the underwork.
- Be kept free from accumulated water, mud or debris either be free-draining or equipped with an automatic mechanical drainage.



The length of approach will depend on the overall length of the weighbridge. Note proximity to the site office.



A level concrete pad at the approach to a weighbridge keeps trailers level if prime-mover and trailers are weighed separately.



Load cell and weighbridge located above ground allows easy access for maintenance and re-calibration, and good drainage.



A multiple deck weighbridge allows the truck to be weighed in a single measurement.



This weighbridge can take systems up to B-Doubles (in length), but a road-train would need to be weighed one trailer at a time.



Boldly painted bollards placed at the entry and exit guide the truck driver and protect the weighbridge sides.

A weighbridge without a pit must provide

- At least 150mm clearance under the lowest live part of the platforms.
- A floor between the load cell supports that is made from concrete at least 75mm thick, that drains effectively and is kept free from accumulated water, mud or debris.
- Sufficient clearance from the external edges of the platform for servicing, maintenance and drainage.
- Stable load cell footings.

All electrical or electronic devices must be protected from the weather and electronic interference. The indicating device, and any summing device, is usually located in the feedlot office.

Truck dimensions

The weighbridge needs to be able to measure all trucks and other vehicles that are likely to require weighing. These may include

- Body truck (e.g. flat bed or tippers) with rigid chassis and bed of various lengths - up to about 12.5m.
- Semi-trailer – prime mover and load-carrying trailer with axles at the rear. The trailer is connected to the prime mover by means of a king pin. Typically this set up is about 19m in length.
- B-Train principle – B-Doubles, B-Triples or three trailers (B-Triples). A prime mover towing at least two trailers (B-Double). The trailers have a turn table at their rear, which another semi-trailer can connect to without the need for a convertor dolly. Typically this set up has a minimum length of 25m.
- Road Train – a road train is a combination other than B-Train, consisting of a prime mover towing at least 2 trailers. The second and subsequent trailers are usually a five or six axle dog trailer/s and connected to the first trailer with a convertor dolly. Road trains have a length of 36.5-53.5m.

Weighbridge access

Feedlot weighbridges should provide two-way access so that trucks can be weighed coming into and out of the feedlot. The access should allow trucks to straighten before they drive on to the weighing deck(s). *Section 13 – Access and internal roads* provides data about the turning circles needed for vehicles likely to be operating at feedlots. Installing markers, such as boldly painted, tall bollards, helps drivers to align vehicles with the weighbridge entrance. Good visibility on the approach and exit of the weighbridge should be provided.

Construction

The process of constructing a weighbridge includes construction of a foundation slab, followed by the construction of the weighing platform(s). Typically, the weighing platform(s) are constructed on the foundation slab and then jacked into position. The weighing platform(s) require sufficient lateral support to prevent platform deflection under heavy loading. Typically, weighbridges are designed by a suitability qualified and experienced structural engineer, or a company specialising in weighbridge installations.

Safety issues

The weighbridge and surrounding area must provide a safe working environment for drivers and other feedlot employees. Adequate directional and safety signage and clearance from other vehicle movements around the weighbridge should be provided. If sampling of feed commodities from an elevated deck is required, the design of the sampling deck (including handrails) must comply with relevant work, health and safety regulations and should be long enough to access all parts of the load.

Site drainage

The weighbridge site must drain rapidly after heavy rainfall and the deck and load cells must not be left inundated with standing water. Mud and other debris must not be allowed to accumulate around or under the weighbridge. If the site does not provide for free drainage, automatic mechanical drainage should be installed.



Weighbridge platform construction – concrete platform and reinforcing mesh needs to be well connected to the main lateral beams to prevent buckling.

Possible solutions

Weighbridge design alternatives are listed below. The choice for each site will depend on feedlot size, expected vehicle types, weighbridge location and other site specific factors.

Design choices include

- Deck type – steel only or steel and concrete decks.
- Deck length – single deck/multiple deck.
- Above ground/semi-pit or fully in ground installation.



Example of safety signage.

Concrete and steel deck

Advantages		Disadvantages	
Long-lasting surfaces	Provided the concrete is prepared correctly (vibrated and cured and steel reinforcement is positioned correctly), concrete is durable with hard-wearing surfaces.	Longer installation process	Both steel only and concrete and steel weighbridges require a concrete foundation. Concrete requires at least two weeks for curing to a suitable strength to allow the deck construction on the top. Concrete and steel decks then require a second curing period, whereas steel only weighbridges do not.
Heavy structure resists severe deck movements	The mass of the deck is significantly more than a steel only weighbridge and this mass resists movement as a vehicle enters or exits the weighbridge. This minimises rocking of the load cells.	More difficult to relocate	Concrete and steel weighbridge decks are heavy and typically larger than small, steel only modules. Relocation is therefore slower and more costly.
Less heat expansion	While the concrete and steel weighbridge uses steel main beams and cross pieces that will expand with heat, this movement is far less than with a steel only weighbridge. This minimises load cell off-centre loading.	Generally more expensive	With the trend towards minimal steel in steel only weighbridges, concrete and steel weighbridges are generally more expensive. However, if a steel-only deck is designed with sufficient steel, prices will be similar.
More confidence in the structural integrity	While concrete and steel weighbridges are not immune to structural failure, concrete and steel weighbridges have been shown to be longer-lasting.		

Steel-only deck			
Advantages		Disadvantages	
Long-lasting surfaces	Galvanised or well-painted steel is hard wearing. Even when the surface coating is damaged, steel forms a skin rust that prevents further corrosion. Weight for weight, steel is stronger than concrete.	Quantity of steel used must be questioned	Because the tops of steel decks are covered in a floor plate, it is difficult to ascertain just how much structural steel is used to fabricate the steel only deck. A general indication is the price of the deck. The lower the price, the less steel is used.
Fast and easier to install	Steel decks are usually fabricated in smaller modules and these modules are joined together to form the complete deck. The modules are easy to manipulate with a crane and easy to transport.	Lighter structure means more severe movement on the load cells	A steel deck is much lighter than a reinforced concrete deck and will move more vigorously as vehicles enter and exit the weighbridge. This causes more severe rocking movements and may compromise the longevity of other weighing components.
Easier to relocate	Light and small modules are easy to manipulate with a crane and easy to transport. But the concrete foundation is obsolete.	Steel expands more with heat	Both concrete/steel and steel only weighbridges expand with heat from the sun. Steel only weighbridges expand more, which means a larger buffer gap is required - allowing load cells a greater range of rocking movement. Load cells, especially end load cells, are also forced on to greater angles with the expansion, introducing greater off-centre loading.
Generally less expensive option	Steel only decks are generally less expensive, but this obviously depends on the amount of steel used. More steel makes a deck stronger, but requires more fabrication and labour to weld steel pieces together.		



Above-ground truck weighbridge with commodity sampling platform.

Deck lengths and installation options

Weighbridges can be single or multiple deck, and can be installed above ground (Figure 1), semi-pit (Figure 2) or fully in the ground (Figures 3 and 4).

1. Above ground Weighbridges

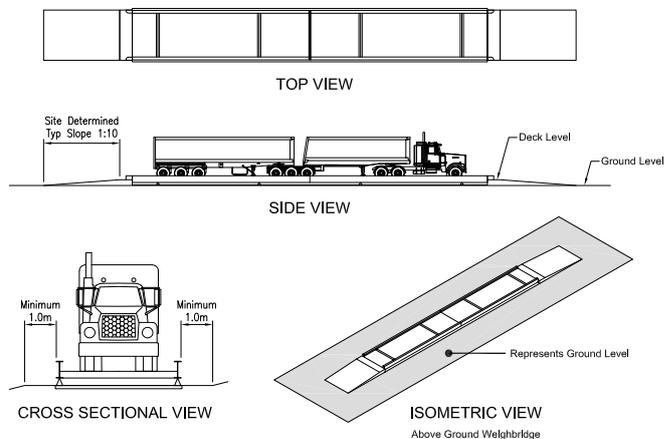


Figure 1. Above-ground weighbridge.

2. Semi-Pit Weighbridges

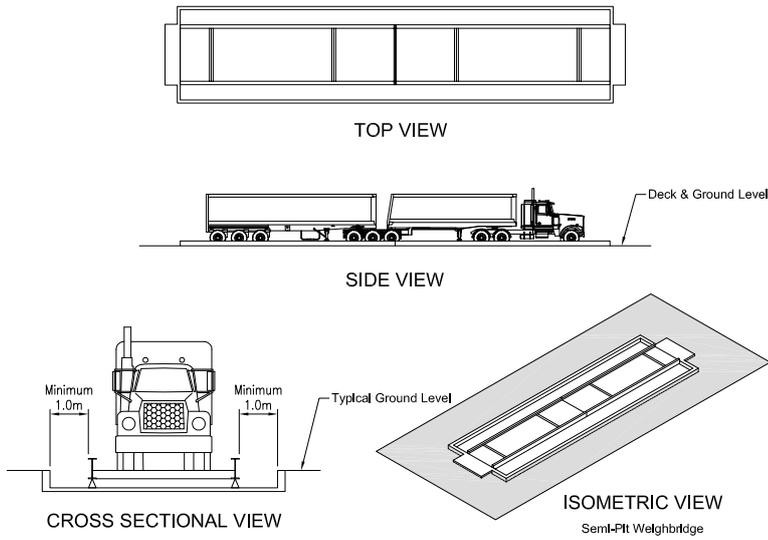


Figure 2. Semi-pit weighbridge.



Semi-pit weighbridge.

3. Fully In-Ground Weighbridges

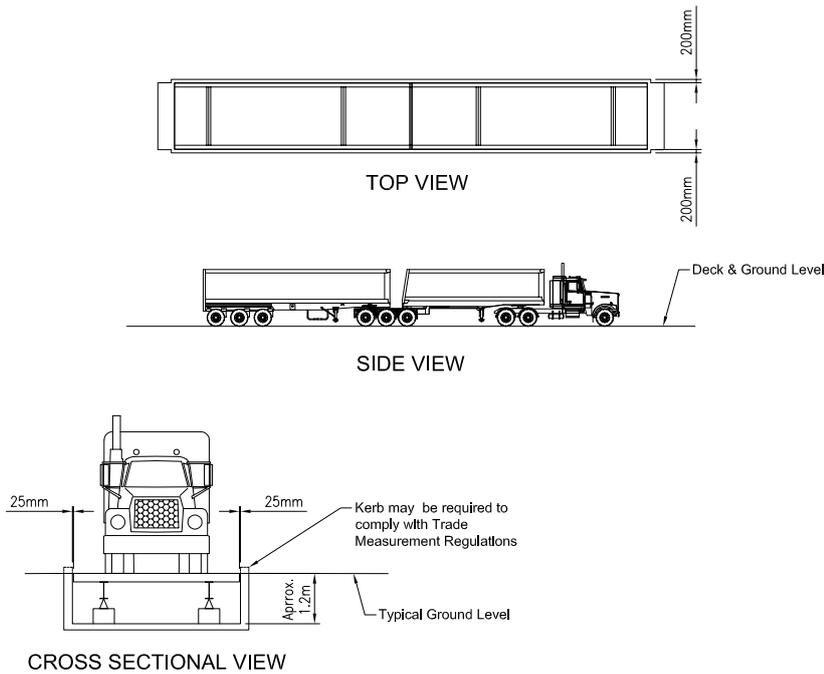


Figure 3. Fully in-ground weighbridge (top, side and cross-section view)



This weighbridge platform is too short for weighing prime mover and trailer together.

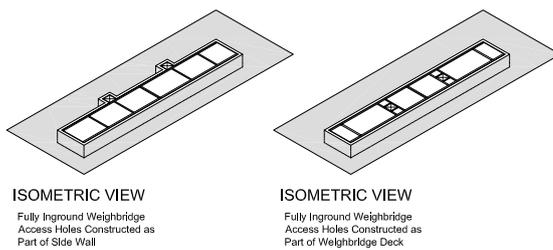


Figure 4. Access holes in fully in-ground weighbridges (isometric view)



Weighbridge for standing cattle.

Cattle weighbridges

While some feedlots weigh incoming cattle on the delivery truck, others provide a separate facility to weigh the cattle when they are unloaded and rested. The construction principles of a cattle weighbridge are similar to those of a vehicle weighbridge, except these are generally smaller and cattle tend to be weighed in batches to facilitate ease of handling.

To prevent injury to the cattle, the weighbridge will need a non-slip floor, which can be a removable structure for ease of cleaning. The need for regular washdowns of this facility will favour an above ground type of construction.

Quick tips

- Ensure weighbridge design and construction meet legislative requirements.
- Locate the weighbridge on the entrance road into the feedlot adjacent to the main office.
- Position the weighbridge so that the operator has a clear view of all platforms and the measured weigh without having to move.
- Provide straight access and distance markers to allow truck drivers to correctly position the vehicle on the platform.
- During design and construction, ensure there is sufficient lateral support provide to preventing ‘twisting’ of the platform—which can result in failure.
- For concrete and steel weighbridges, attention should be paid to how the concrete platform is connected to the steel beams. Poor connection can lead to failure.
- For grain sampling, provide a platform that is the same length as the platform deck. This will allow sampling/inspection to occur without the truck having to move forward or reverse backwards while on the weighbridge deck.
- Design the weighbridge site to drain freely after rainfall.
- Provide ready access to load cells and other areas needing regular maintenance or cleaning.

Further reading

National Measurement Institute (<http://www.measurement.gov.au/Pages/default.aspx>)

National Trade Measurement Regulations 2009 (<http://www.comlaw.gov.au/Details/F2009L03479>)

Verifying weighbridges (<http://www.measurement.gov.au/Services/Training/Pages/VerifyingWeighbridges.aspx>)