

PBS – OPPORTUNITIES FOR IMPROVED SAFETY

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Abstract

This paper provides a case study for the development and implementation of improved safety systems for a Performance Based Standards (PBS) vehicle in Newcastle Australia. The mechanisms that contribute to improved vehicle safety are summarised both above and below the deck, with emphasis on the Load Restraint system development and performance.

The paper intends to demonstrate the capacity for high productivity vehicles to provide a measurable increase in safety and environmental benefits for the community.

Conclusions are provided on the opportunity provided by PBS vehicles to implement improved safety systems above the deck and provide quantifiable gains in transport safety.

Keywords: PBS, Load Restraint, Newcastle, OneSteel, Freight Transport, Symposium

1. Freight Task

1.1 Background

Following the split of Smorgons Steel between OneSteel and BlueScope Steel, the product flow between the various OneSteel sites in Newcastle experienced some significant changes.

The former Comsteel site at Frith Street Mayfield located at Waratah was responsible for the production of additional Merchant Bar material to be dispatched to the OneSteel Rod and Bar Mill rail head in Mayfield.

The process of maximising both the feed material and the finished product flow in and out of the Waratah site is the freight task which has been targeted for the implementation of a PBS vehicle.

1.2 The Freight Task – Detail

The source material for the production of Merchant Bar is steel billet, which is sourced from the OneSteel rail head, located at the Rod and Bar Mill at Mayfield some 9 kilometers from the Waratah site. The billet material is transferred from the rail head to the Waratah site via road on 19m articulated vehicles.

The finished product is dispatched from the Waratah site back to the rail head via road utilising the 19m articulated vehicles. See Figure 1.

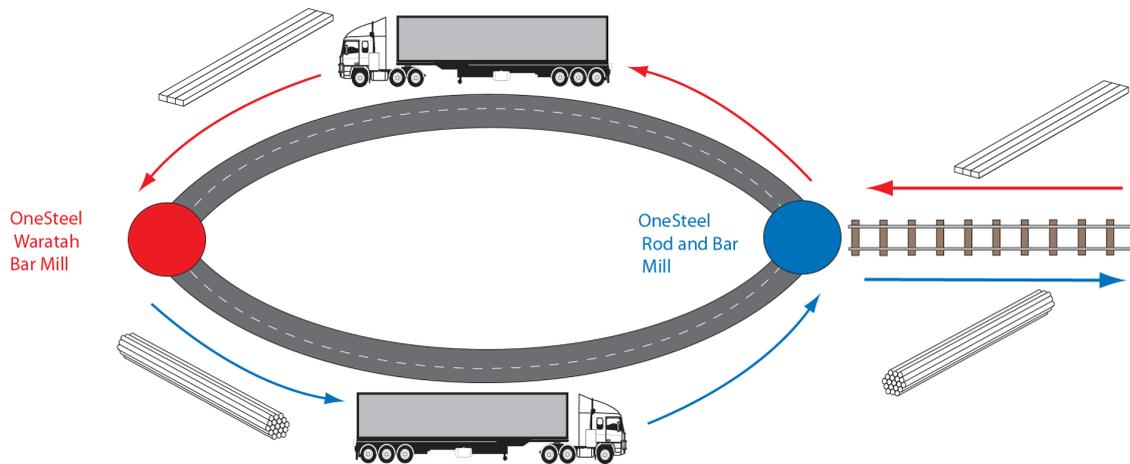


Figure 1 – Schematic of freight task

2. The PBS Vehicle

The PBS vehicle selected for the route is an A-Double style twin trailer combination with 2 identical trailers coupled with a steerable Dolly unit (patent pending). This combination is designed and manufactured by Haulmark Trailers in Brisbane, Australia with an 85 tonne Gross Vehicle Mass (GVM).

The vehicle combination has been fitted with a specialised load restraint system to allow reduced loading and unloading times which is discussed further in section 5.

A diagrammatic view of the vehicle is provided in Figure 2.

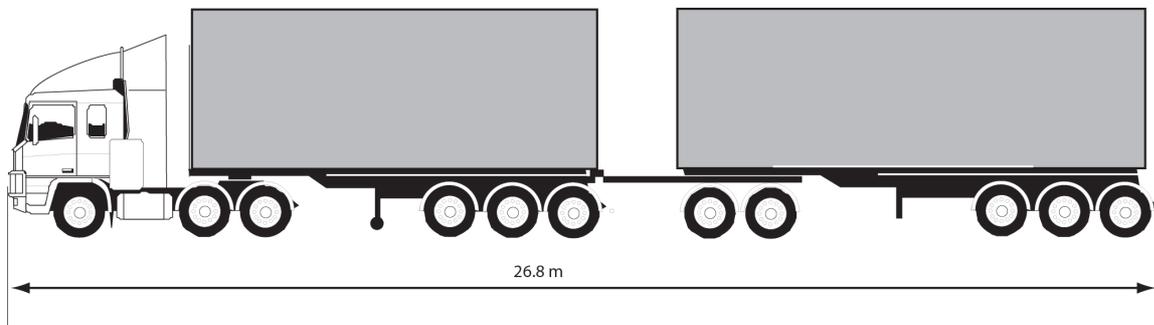


Figure 2 – Haulmark A - Double Vehicle for freight task

3. Vehicle Safety benefits – Below deck

The PBS design requirements include 16 safety standards to improve road safety. These design features include both the dynamic behavior of the vehicle and the physical attributes on of the design, such as Front/Rear/Side under run protection.

The capacity of the vehicle to perform evasive action whilst at high speeds (60km+) whilst maintaining directional control over the entire vehicle length, is a key safety feature of the A Double. Testing at Anglesea test facility was able to show the dynamic behavior of the vehicle in situations such as high speed lane change with the articulated Dolly axle in the active and passive mode.

The activation of the articulated axle on the Dolly for such tests made a clear improvement of the vehicle dynamics. This enables the entire combination to operate within a reduced space envelope even at high speeds with evasive actions undertaken.

The braking systems on the vehicle also have been demonstrated to be operating at very efficient levels, with braking decelerations of greater than 0.8g experienced in load restraint testing. This increased braking efficiency allows for shorter stopping distances and an increased likely hood of reduced vehicle impacts.

The dynamic performance and some key vehicle design features for the A Double are a validation that the 16 safety standards in the PBS design criteria are able to provide a measurable increase in transport safety.

4. Vehicle Safety benefits – Above deck

As part of the implementation of the A Double, the loading and unloading time needed to be addressed. Providing a more efficient vehicle in terms of payload addressed the issue of increasing the quantity of feed material coming into the Waratah site, however utilising the same load restraint system remained a restriction on the product flow.

4.1 Existing restraint method and associated issues

The existing load restraint system comprised of 6 belly wrapped chains for the Billet product and 6 to 7 Belly wrapped chains for the Merchant Bar product loads, dependant upon payload mass. See Figure 3.

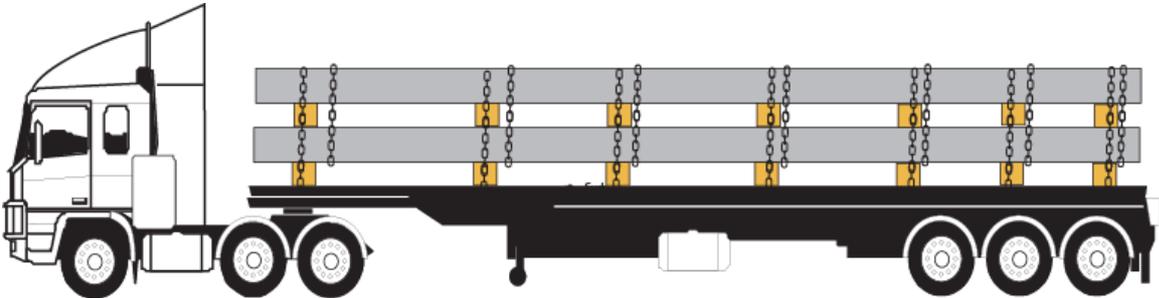


Figure 3 – Existing Restraint method – approx 7 Belly wrapped chains

The typical time to apply the existing restraint for the Billet or Merchant Bar could be up to 30 minutes. The time to remove the restraint was comparable at approximately 20 minutes.

In terms of application, the existing system of belly wrapped chains is sensitive to the correct method. There are multiple opportunities for drivers to incorrectly apply the restraint chains, any of which can critically impact the load restraint performance.

With the above in mind OneSteel initiated the process of development for an improved restraint system, to resolve the above safety and efficiency issues, maximising the benefits of implementing the A Double vehicle.

4.2 Development of the improved Restraint system

The development of the improved restraint system for the OneSteel Freight Task followed a typical design process with phases of development from task brief and concept through to detailed engineering and prototype testing.

The clear message from OneSteel was the need for a simplified system that provided improved load security with less manual handling and reduced loading and unloading times.

4.3 The sliding headboard solution

The restraint system was required to accommodate product lengths of 5m to 9m and payload of 29 tonnes, whilst maintaining compliant axle loading. This requirement excluded any fixed system of blocking and was the catalyst for the development of the sliding headboard system.

The design loads for the restraint system are taken from the National Transport Commission Load Restraint Guide second edition 2004, with nominated loads of 0.8g forwards, 0.5g sideways (transverse to vehicle), 0.5g rearwards and 0.2g vertically upwards.

The nominated concept for development was a full size 900mm high, engineered frame that traveled longitudinally on the vehicle deck and was secured in place with 75mm webbing straps.

The headboard frame was designed to minimise mass by evaluating the relevant shear and bending loads on the critical components. Loads applied to the slide rail, bearings and attachment bolts were also determined and the components selected accordingly.

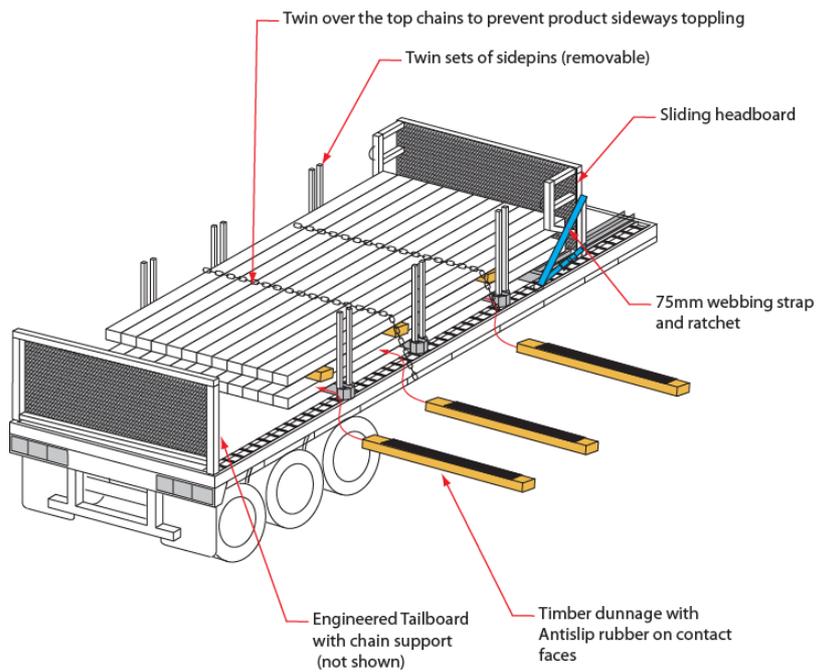


Figure 4 – Sliding headboard and side pins load restraint system

Lastly the rearwards and sideways restraint loads were calculated and side pins and a tailboard developed specifically to meet these loads and ensure system compliance. The resulting system is shown in Figure 4.

4.4 Load Restraint Testing

To validate the capacity of the system and to identify any user issues, load restraint testing was performed. The testing was completed in two separate sessions, with Merchant Bar and Welded Beam product. The test results were satisfactory, with applied loads in excess of the design loads recorded with no uncontrolled product movement or visible distress of any component.

5. Benefits provided by Sliding Headboard system – Safety and Productivity

A function of the sliding headboard restraint system is the capacity to provide dual benefits of safety and productivity gains as concurrent outcomes. These benefits are described below;

5.1 Manual handling reduction

The elimination of the need for belly wrapped chains as the primary source of load restraint is a key safety feature of the improved restraint system. Each application of a belly wrapped chain requires the chain to be projected over the load twice. The sliding headboard system eliminates the need for Belly wrapped chains and has two (2) chains applied directly over the top of the load. This reduces the manual handling of the restraint chains from fourteen (14) tasks to two (2) tasks for the same product mass.

The manual handling reduction of 86% is calculated with the reduced handling tasks.

5.2 Error tolerance and increased system redundancy.

The sliding headboard system has been designed to anticipate potential failures and incorporate design features to either prevent the problem occurring or alternatively minimise its consequences. The result of this approach is that the system is tolerant of user errors and or loads applied above design requirements.

An example of this approach is the composite dunnage which consists of timber and Antislip rubber bonded together, sitting on a fabricated steel base. Should the high friction rubber be worn, the resulting surface is timber, which provides a smaller reduction in static friction than the Antislip rubber and steel surface.

A product of this approach is that the system is ultimately capable of withstanding loads higher than those nominated in section 4.3. This additional capacity is achieved with minimal TARE mass increase and without additional actions on the part of the user.

5.3 Productivity benefits

Productivity benefits have been achieved with the implementation of the vehicle and the sliding headboard system. Early use of the system indicates that the new restraint system has allowed 3 additional loads per day due to the reduced time to apply the load restraint. This equates to an approximate efficiency gain of 50%.

6. Summary

The implementation of PBS vehicles offers an opportunity to look at the freight task from a holistic perspective and develop systems that compliment the vehicle, improving safety and productivity as dual outcomes. A key part of this process is the principle of “building in safety” into the design phase as a primary focus.

Detailed engineering focused on a user friendly error tolerant load restraint system, can deliver benefits to the freight task well into the future, with the combined benefits far outweighing the initial investment.

7. Acknowledgements

Haulmark Trailers Rocklea, Brisbane, Australia
OneSteel Market Mills Australia
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Toll Contract Logistics – BlueScope Steel Acacia Ridge QLD

8. References

National Transport Commission Load Restraint Guide Second Edition 2004
HVTT11: PBS – Opportunities for Improved Safety, Carlson, Robertson