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Applying Performance Standards to the Australian Heavy Vehicle Fleet

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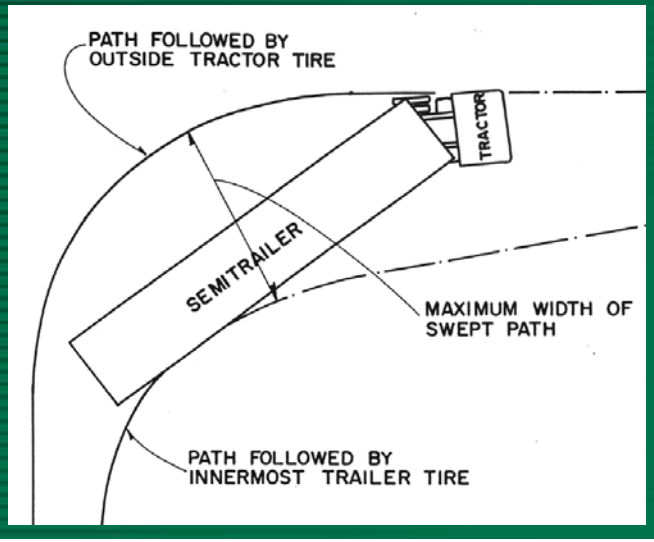
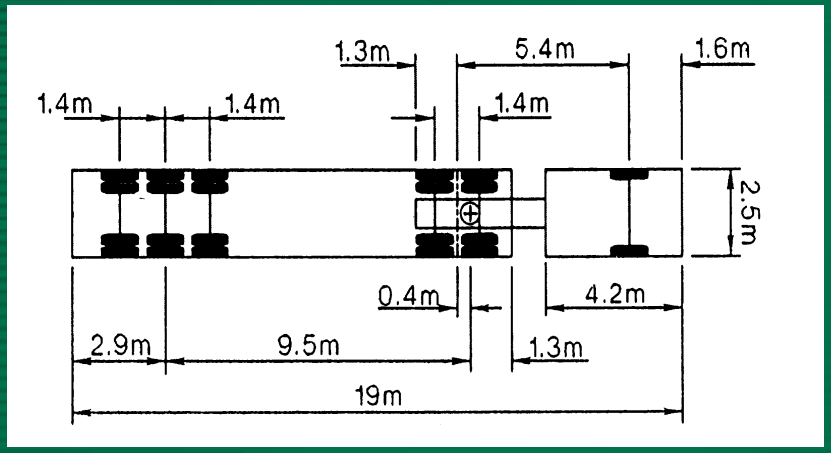
IRTENZ Rotorua - August 2002

What is PBS?





- What a vehicle should do...
- Instead of what it should be like

Objectives

- More sustainable transport systems
  - improved road vehicle regulations
  - controlling safety and infrastructure impacts
- More flexible regulations
  - increased innovation
  - more rapid adoption of new technologies
  - seamless operations nationally

Responsive

- PBS is responsive to industry needs for innovation
  - brings requests for exemptions inside the system
  - innovations dealt with more quickly, broadly and consistently

Optional

- PBS is voluntary for heavy vehicle operators
- For those who decide not to operate under PBS nothing changes

Partnerships

- PBS is not a free-for-all
  - road safety and infrastructure protection must be guaranteed
- Industry has to play its part
  - compliance must be guaranteed

Implementable

- Based on Policy Framework approved by all Transport Ministers
- Regulatory processes taking shape
  - build on current systems rather than duplicate them
- Designed from the start as a national system

Principles

- National alternative system of regulation
  - some rules still apply
  - alternative to mass, dimension and configuration rules
  - if operating outside PBS must meet prescriptive rules
- Match standards to road and traffic conditions
  - standards vary for road classes
  - road authorities assess routes

Principles

- Nationally consistent, practical compliance assurance
  - vehicle certification
  - operating conditions
    - accreditation where warranted
- Chain of responsibility applies

How it will work

- Independent assessors engaged by proponent
  - they assess whether the proposal meets the standards and what operating conditions need to apply to guarantee compliance
- Road authorities determine what class of standards are appropriate for each road they manage

Features

- Assessors need to be accredited to stringent standards
- Anyone can make an application
- Flexibility to move in & out
- Mutual recognition

Benefits

- PBS is for the benefit of the industry and the community
  - allows industry to develop productivity innovations
  - introduces a safer vehicle fleet

Examples

Quad/quad B-double on appropriate parts of the road network

Examples

Steerable axles may allow greater access for longer combinations

Examples

More cube space on rigid & articulated trucks

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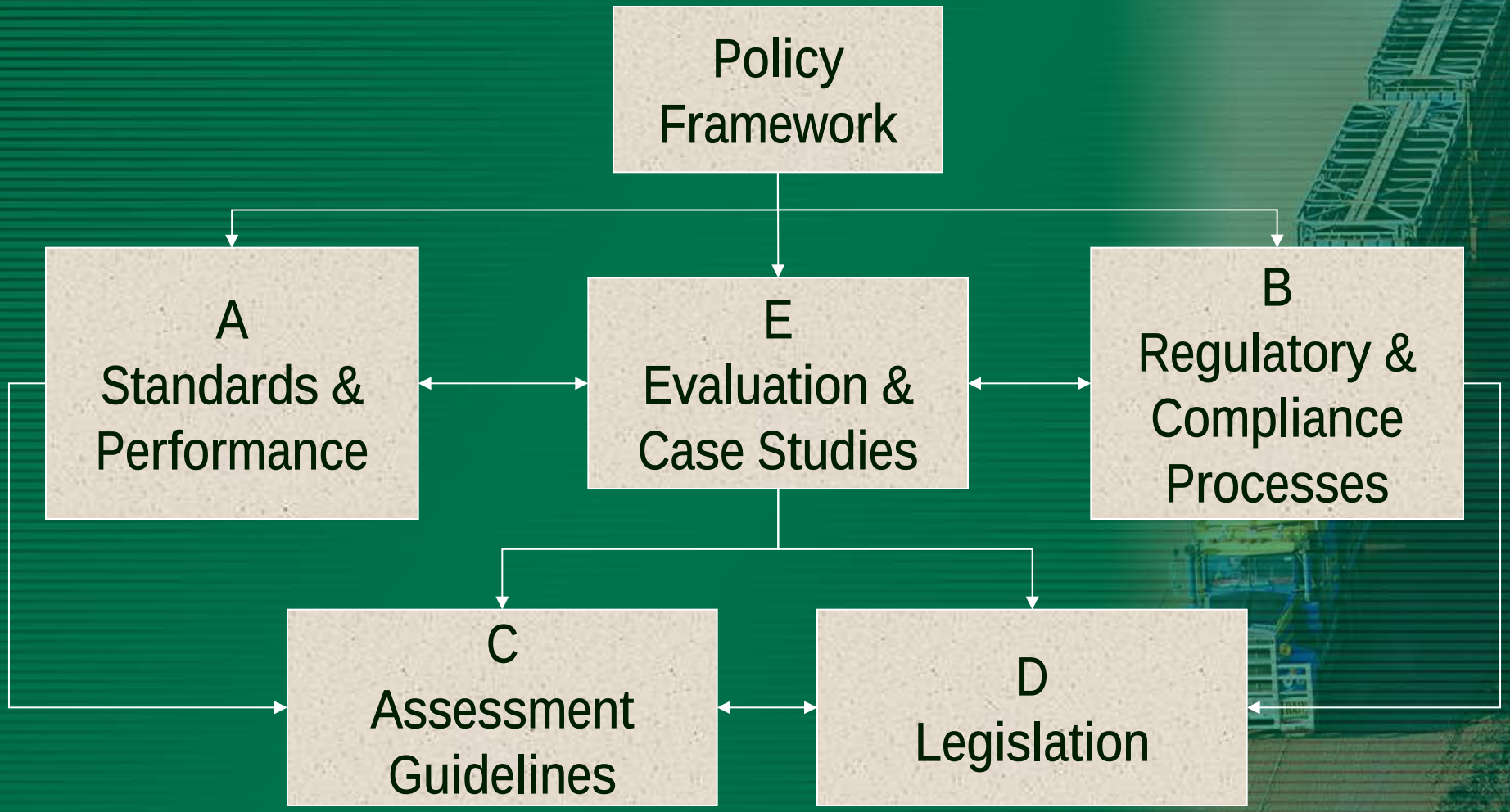
Project Description

Project Components



A3/A4 Sub-project

- Aims
  - establish nationally agreed set of standards
  - establish performance of existing fleet

A3/A4 Sub-project Outputs

- Specification of approach
- Initial selection of measures
- Definition of measures and initial standards
- Characterisation of current fleet
- Comparison of modelling systems
- Workshops summary
- Fleet performance
- Regulatory Impact Statement (preliminary draft for comment)

Progressive Elimination of Standards to Current Set

- Report - “Field of Performance Measures” by Roaduser International, December 1999
- PBS in other fields
  - Health and Safety
  - Australia & NZ Food Authority
- Identified 97 potential performance measures as the initial set

Categorisation of the Initial Set of Performance Standards

- 48 Safety
- 9 Infrastructure
- 12 Productivity
- 2 Amenity
- 21 Road-vehicle interaction
- 5 Environmental

97 TOTAL

"Report on Initial Selection of Potential Performance Measures" by ARRB PBS Project Team.

- Six steps were used in a selection process to reduce the 97 potential performance measures to a set of 25 that cover safety and infrastructure related issues

- 4 new measures were added for consideration to protect infrastructure
  - maximum load on axles or axle groups
  - maximum GVM/GCM
  - axle spacings to protect short span bridges
  - critical design vehicle

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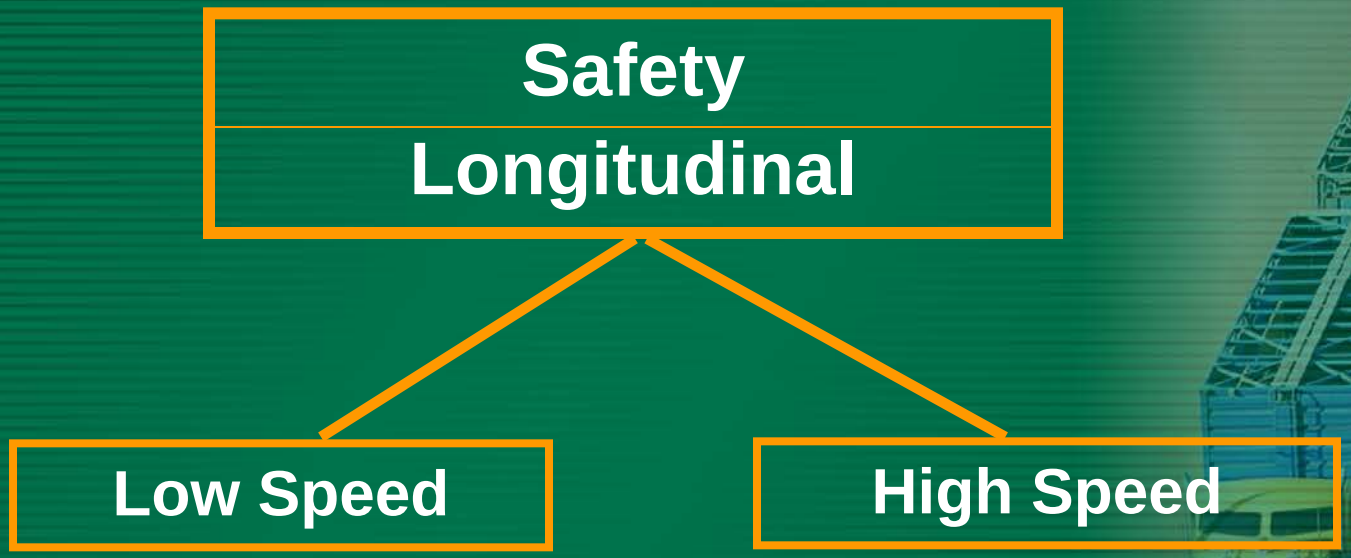
Proposed Performance Measures - Safety

Performance Measures - Safety



1. Startability
2. Gradeability
3. Acceleration Capability
4. Overtaking Time (parked)
5. Tracking Ability on a Straight Path
6. Ride Quality/Driver Comfort (parked)

Performance Measures - Safety

Safety
Directional

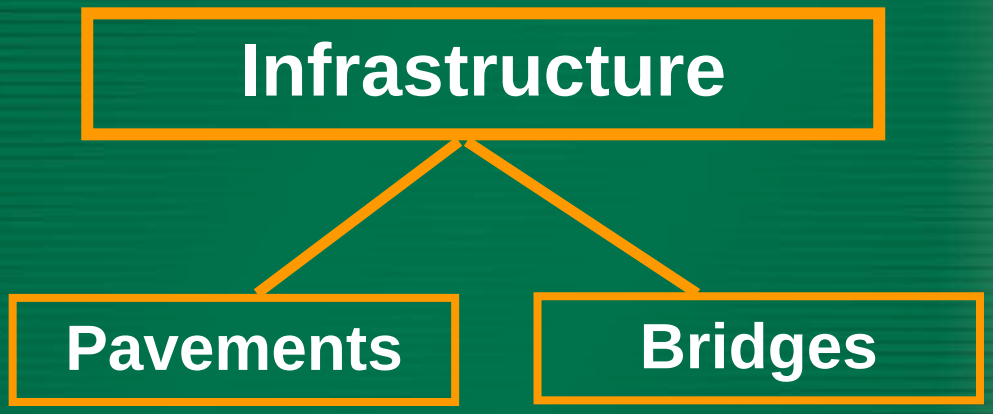
Low Speed

7. Low Speed Offtracking
8. Frontal Swing
9. Tail Swing
10. Steer Tyre Friction Demand
11. Static Rollover Threshold

High Speed

12. Rearward Amplification
13. High Speed Transient Off-tracking
14. Yaw Damping
15. Handling Quality (Parked)
16. Braking Stability in a Turn (Parked)

Performance Measures - Safety

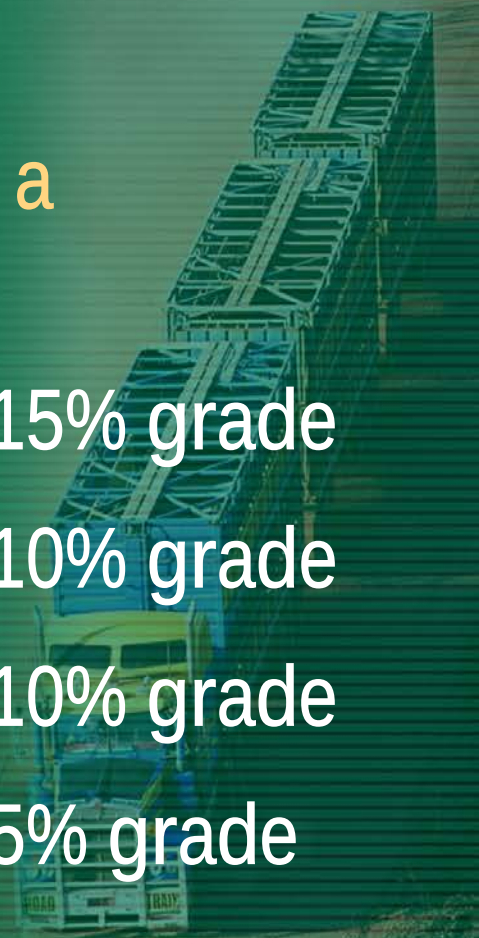


17. Gross Mass per Standard Axle Repetition
18. Horizontal Tyre Forces
19. Tyre Contact Pressure Distribution
20. Maximum Effect Relative to Reference Vehicles

Startability

"Ability to commence forward motion on a specified grade"

- Unrestricted routes - 15% grade
- Significant freight routes - 10% grade
- Major freight routes - 10% grade
- Remote routes - 5% grade



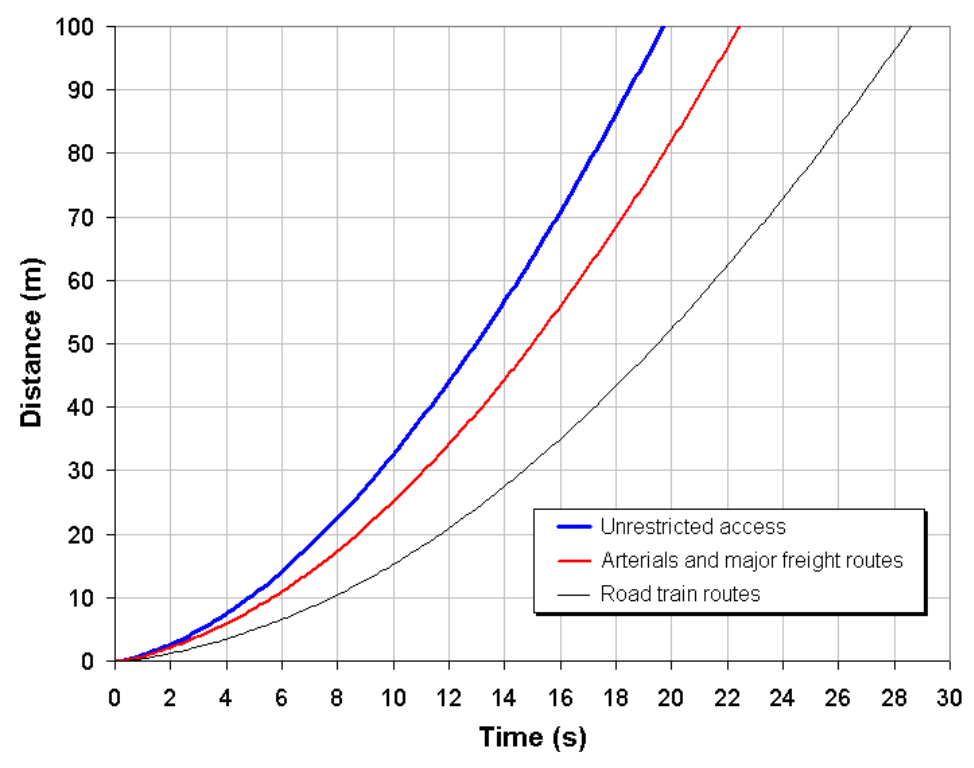
Gradeability

"Ability to maintain forward motion on a specified grade".

- Unrestricted routes : 25% grade; 70km/h on 1% grade
- Significant freight routes : 20% grade; 70km/h on 1% grade
- Major freight routes : 20% grade; 70km/h on 1% grade
- Remote routes : 8% grade; 60km/h on 1% grade

Acceleration Capability

"Ability to accelerate from rest or to increase speed (no grade)".



Tracking Ability on a Straight Path

"Variation in lateral position of the last trailer relative to the hauling unit".

- 1000m road requirement
- 100km/h or highest speed attainable
- road roughness 4.0m/km IRI cross-slope 3%
- vehicle laden

Required lane width:

Unrestricted route:	3.1m maximum
Significant freight Route:	3.3m maximum
Major freight route:	3.5m maximum
Remote Route:	3.7m maximum

Low Speed Off-Tracking

"Maximum distance any part of a vehicle tracks inside the path of the steer axle plus the vehicle width on a low speed turn"

- Speed 10km/h
- Steer axle to follow a straight approach to an 11.25m radius 90° circular arc.

Maximum width of the swept path:

Unrestricted route:	7.4m maximum
Significant freight route:	8.7m maximum
Major freight route:	10.1m maximum
Remote Route:	13.7m maximum

Frontal Swing

"Maximum difference between the path of the outside corner of any unit in a combination and:

(a) the path of the front outside wheel of the hauling unit, or

(b) the front of a semi-trailer or trailer."

- Speed 10km/h
- Steer axle to follow a straight approach to an 11.25m radius 90° circular arc

Maximum frontal swing:

All routes: 1.5m for (a)

Zero for (b)

Tail Swing

"Maximum distance the outer rearmost point on a vehicle moves outwards"

- Speed 10km/h
- Steer axle to follow a straight approach to an 11.25m radius 90º circular arc.

Maximum tail swing:

All routes: 0.35m

Steer Tyre Friction Demand

"Maximum friction level required by the steer tyres of tri-axle group hauling units"

- Speed 10km/h
- Steer axle to follow a straight approach to an 11.25m radius 90º circular arc.

Friction demand to be no greater than 80% of the available tyre/road friction on all routes.

Static Rollover Threshold

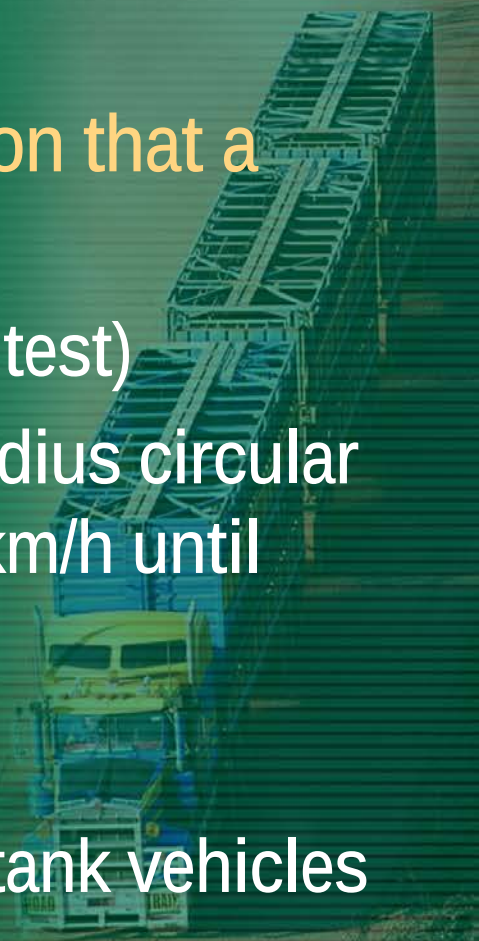
"The steady state level of lateral acceleration that a vehicle can sustain without rolling over"

- Procedures defined in SAE J2180 (tilt test)
- Centre of steer axle follows a 100m radius circular path as test speed increases from 60km/h until rollover (computer-based).

Minimum SRT for all routes:

0.40g buses and dangerous good bulk tank vehicles

0.35 all other vehicles



Rearward Amplification

"Amount which trailing units amplify the lateral motion of the hauling unit in a sudden evasive manoeuvre"

- Lane change manoeuvre as defined in SAE J2179 or in accord with ISO 14791.

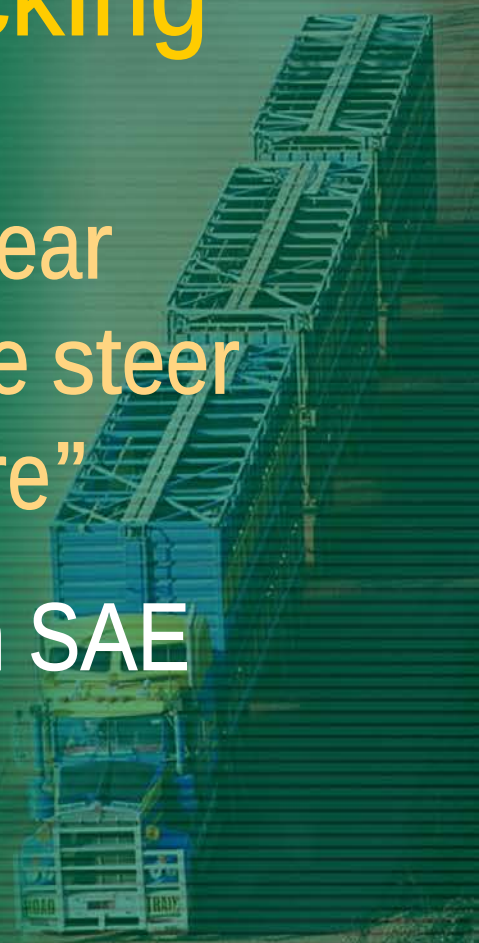
For all routes rearward amplification no greater than 5.7 times the SRT of the rearmost roll-coupled unit.

High-Speed Transient Offtracking

"The distance the last axle on the rear trailer tracks outside the path of the steer axle in a sudden evasive manoeuvre"

Lane change manoeuvre defined in SAE J2179 or in accord with ISO 14791.

All routes: HSTO maximum 0.8m

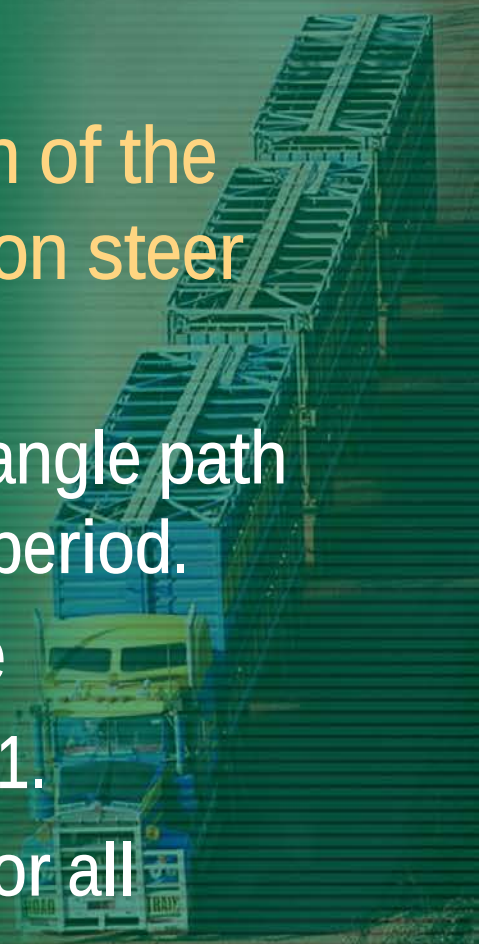


Yaw Damping

"The rate at which sway or yaw oscillation of the rearmost trailer decay after a short duration steer input at the hauling unit"

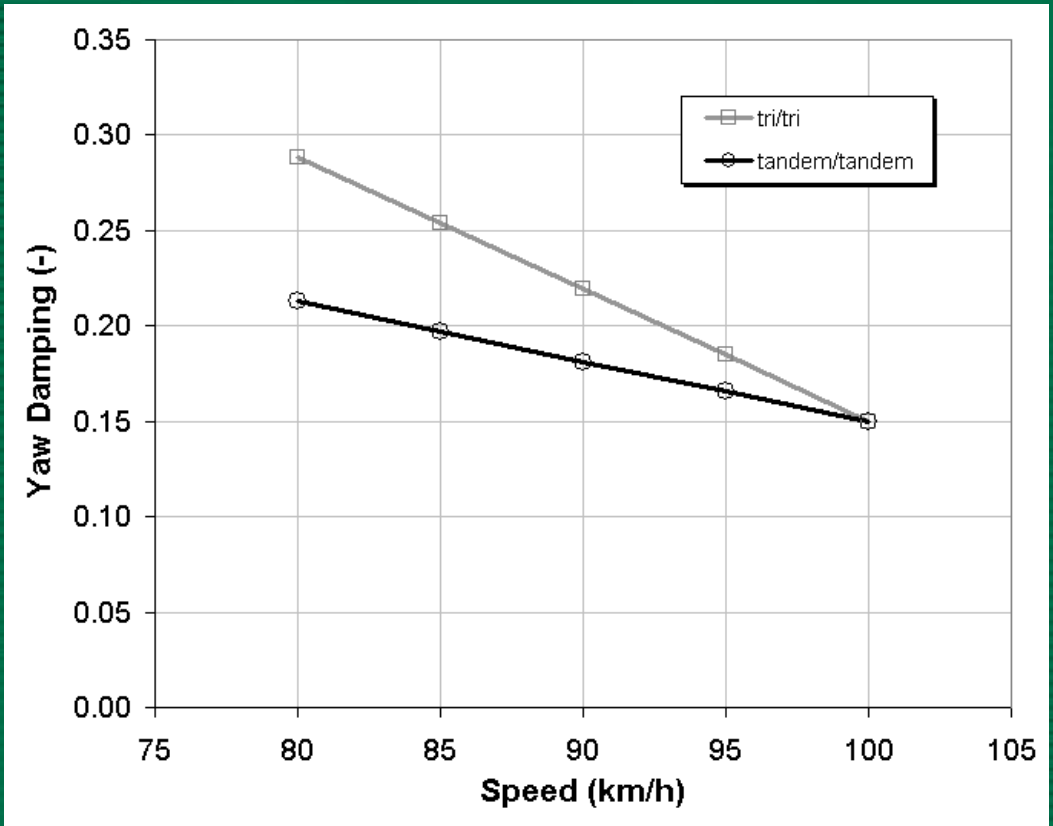
- Application of a 3.2° (half sine) steer angle path at the road wheels over a 0.1 second period.
- Test speed 100km/h or max attainable
- Alternatively: in accord with ISO 14791.

Yaw damping co-efficient no less than 0.15 for all routes.



Yaw Damping (cont.)

Yaw damping co-efficient for road train:



Gross Mass per Standard Axle Repetition

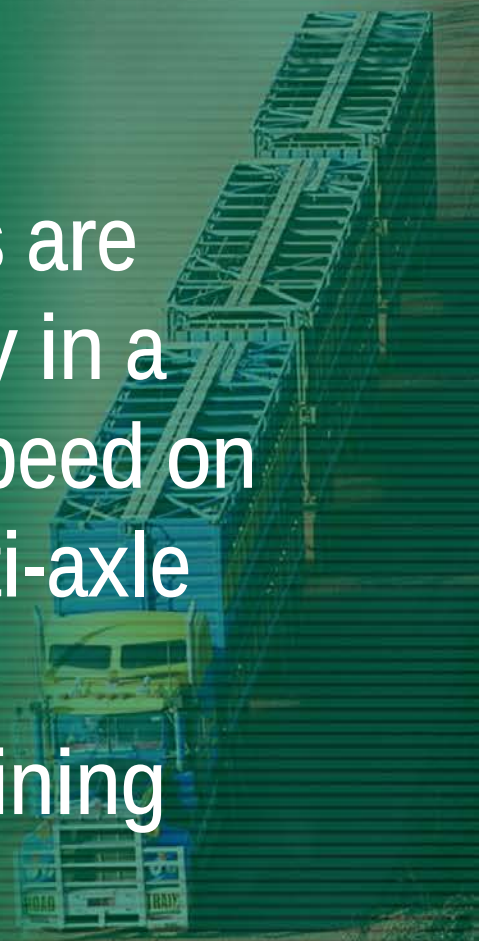
- The Gross Mass (GM) of a heavy vehicle divided by the Standard Axle Repetitions (SARs) applied to the pavement by a single pass of the vehicle

Proposed Performance Level:

- For granular pavements with thin surfacing:
  8.4 tonne per SAR
  - different levels, yet to be determined, may apply to other pavement types

Horizontal Tyre Forces

- Degree to which horizontal forces are applied to the pavement, primarily in a low-speed turn and at constant speed on uphill grades, by the tyres of multi-axle groups (drive-axle group tyres in particular) and the effect on remaining pavement life



Maximum Effect Relative to Reference Vehicle

- The maximum bending moment and shear force induced in a set of representative (or route specific) bridges measured relative to a reference vehicle

Maximum Effect Relative to Reference Vehicle

Proposed Performance Level:

- Bending moments and shear forces to be no greater than the moments and forces induced in the bridge by Austroads BAG Reference Vehicles
- On routes that are not satisfactory for BAG vehicles the worse case legal vehicle operating on that route shall be used as the reference vehicle
- For vehicles transporting indivisible freight, reference loads to be determined by the relevant Road Agency

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Standards to be Further Developed

Which Standards have been designated for further development?

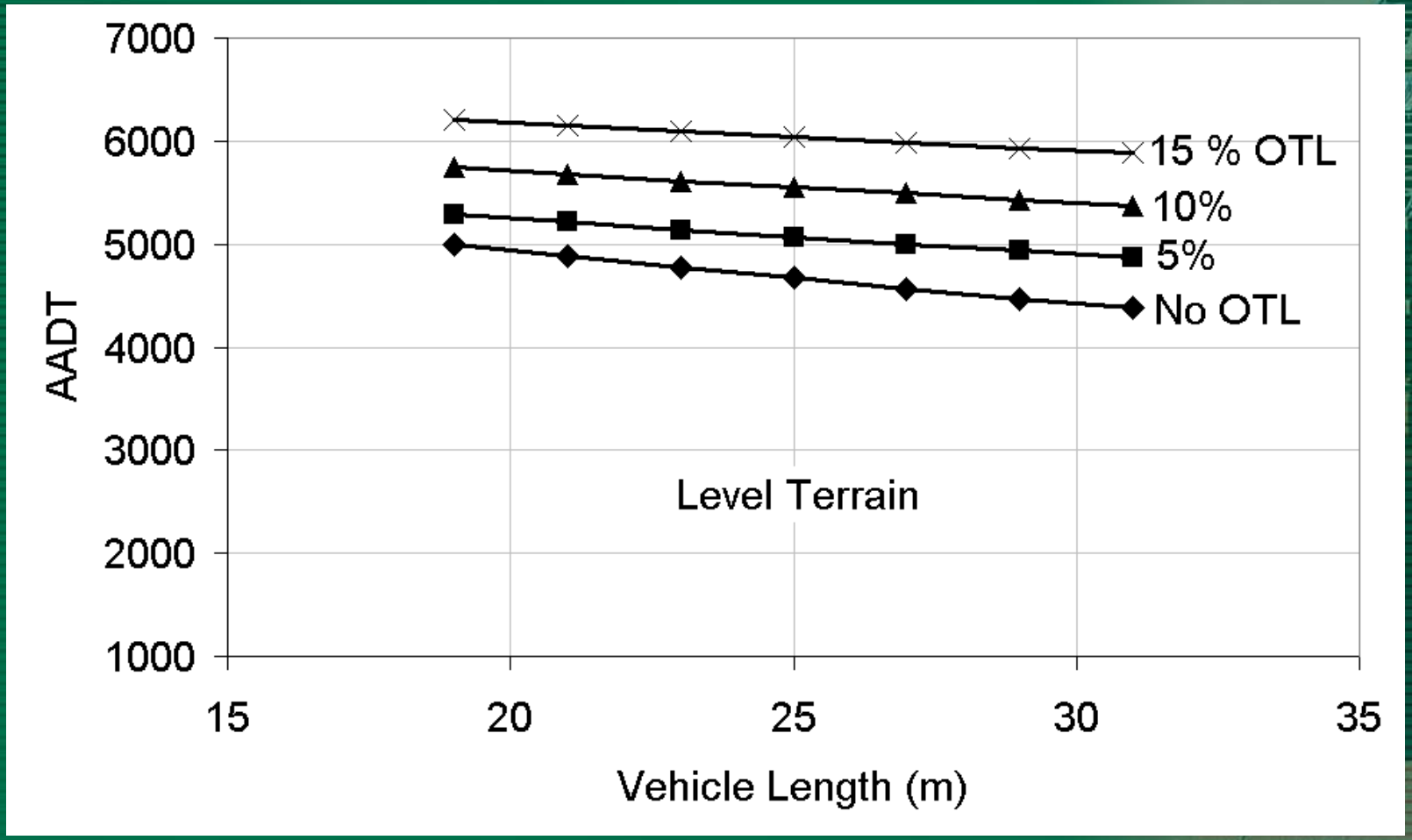
- Overtaking Time
- Ride Quality (Driver Comfort)
- Handling Quality (Understeer/ Oversteer)
- Braking Stability in a Turn
- Tyre Contact Pressure Distribution

Overtaking Time

The initially suggested standard was:

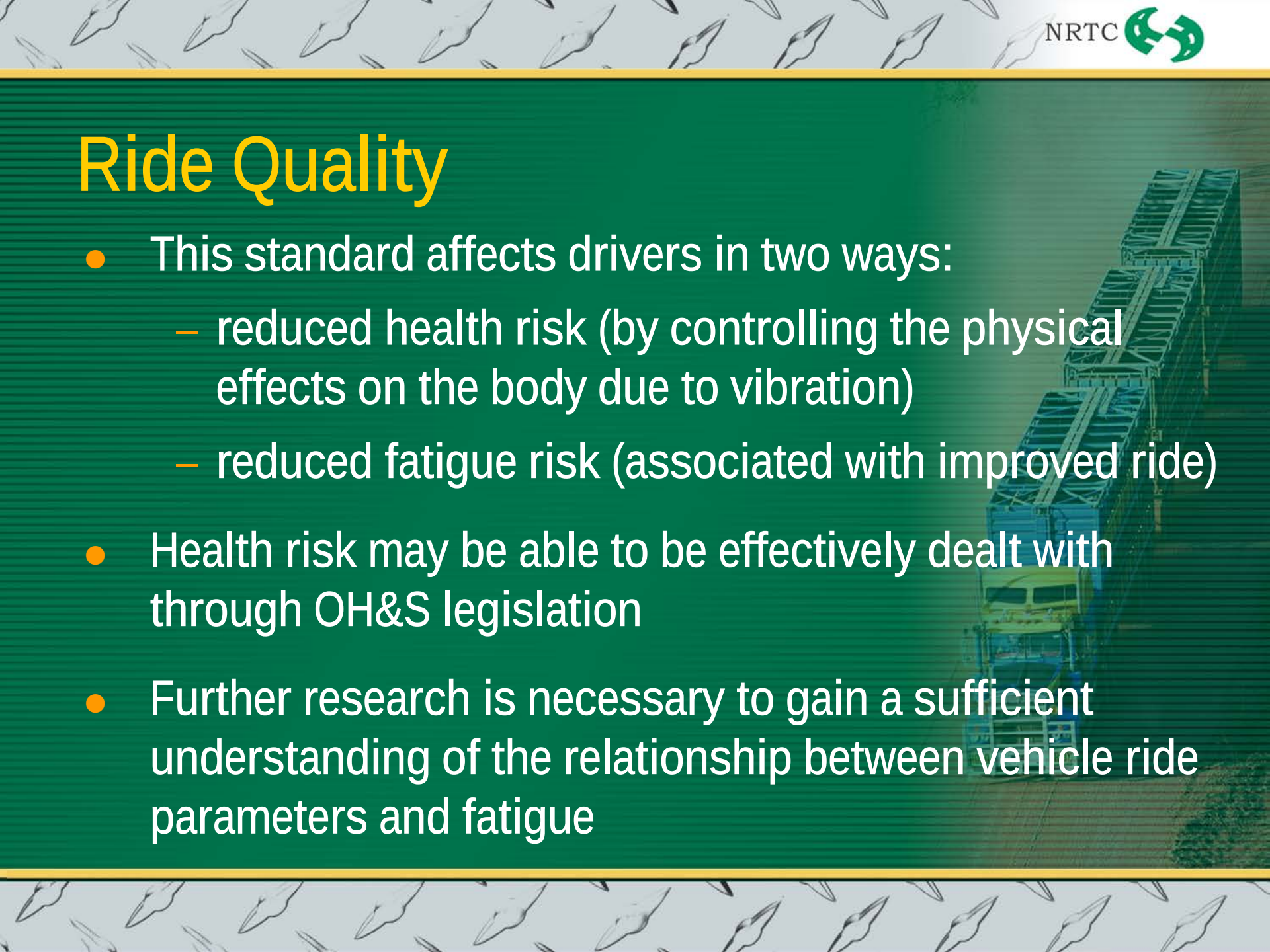
- judged to be too prescriptive (proxy for vehicle length)
- initial standard was developed by back-calculating from existing prescriptive vehicle lengths

Overtaking Time



Ride Quality

- This standard affects drivers in two ways:
  - reduced health risk (by controlling the physical effects on the body due to vibration)
  - reduced fatigue risk (associated with improved ride)
- Health risk may be able to be effectively dealt with through OH&S legislation
- Further research is necessary to gain a sufficient understanding of the relationship between vehicle ride parameters and fatigue



Handling Quality

- This standard is necessary to ensure that a vehicle's response to steering is predictable and controllable
- An international effort will be required to conduct research in this area

Braking Stability in a Turn

- This standard also needs further (possibly international) research
- Present FMVSS Standard 121 is not suitable for immediate Australian application
- There are still industry issues concerning the applicability of ABS brakes in some environments

Tyre Contact Pressure Distribution

- Another standard needing international research
- Current efforts in Australia with respect to crane tyre contact pressures
- Pavement research is needed to determine the effect that different tyre contact pressure distributions have on pavement wear

Tyre Contact Pressure Distribution

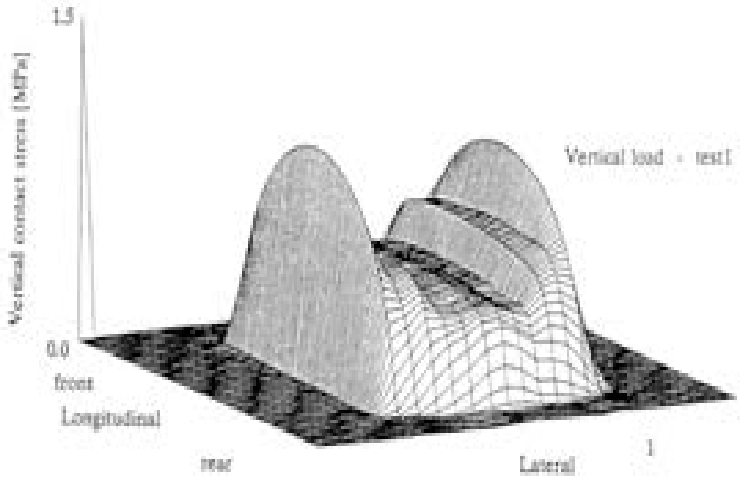


Fig. 16(b) Measured vertical stress distribution of a 60kN load (De Beer, 1996b).

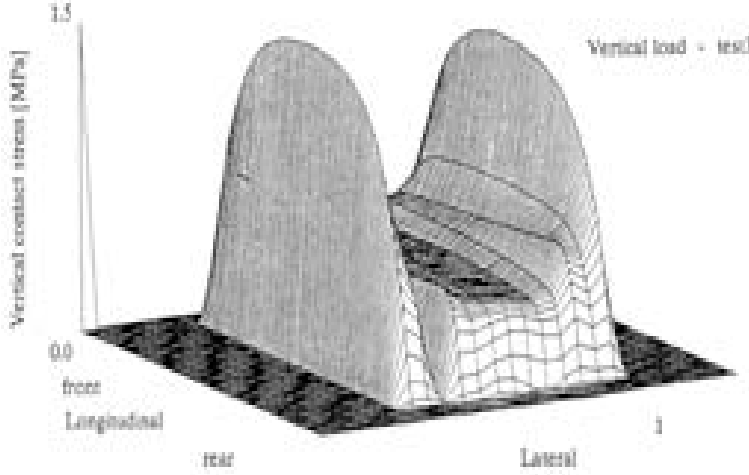


Fig. 16(c) Measured vertical stress distribution of an 80kN load (De Beer, 1996b).

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