RAIB investigations involving freight trains – current areas of concern

Presentation to DB Schenker Rail (UK) 4th Risk Management Seminar on 5 November 2015

The Rail Accident Investigation Branch: Key facts

- **Independent of all parts of the rail industry**
  - ***Functionally independent***
  - ***Chief Inspector - reports to Secretary of State on investigation matters***
- Sole purpose to **improve safety**
  - ***does not apportion blame or liability***
- **Lead Party** in most investigations
- Became operational in October 2005

Legal Basis

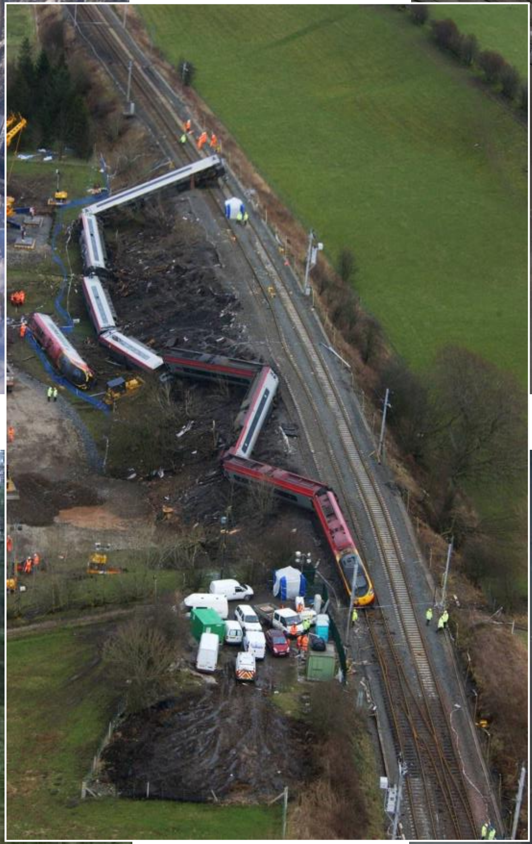
The Railways & Transport Safety Act 2003 - provided for the creation of the RAIB ……

The Railways (Accident Investigation and Reporting) Regulations 2005 - set out the framework in which the RAIB operates and implements the ……

European Rail Safety Directive 2004.

RAIB

Passenger and freight trains, metros, trams, and heritage railways

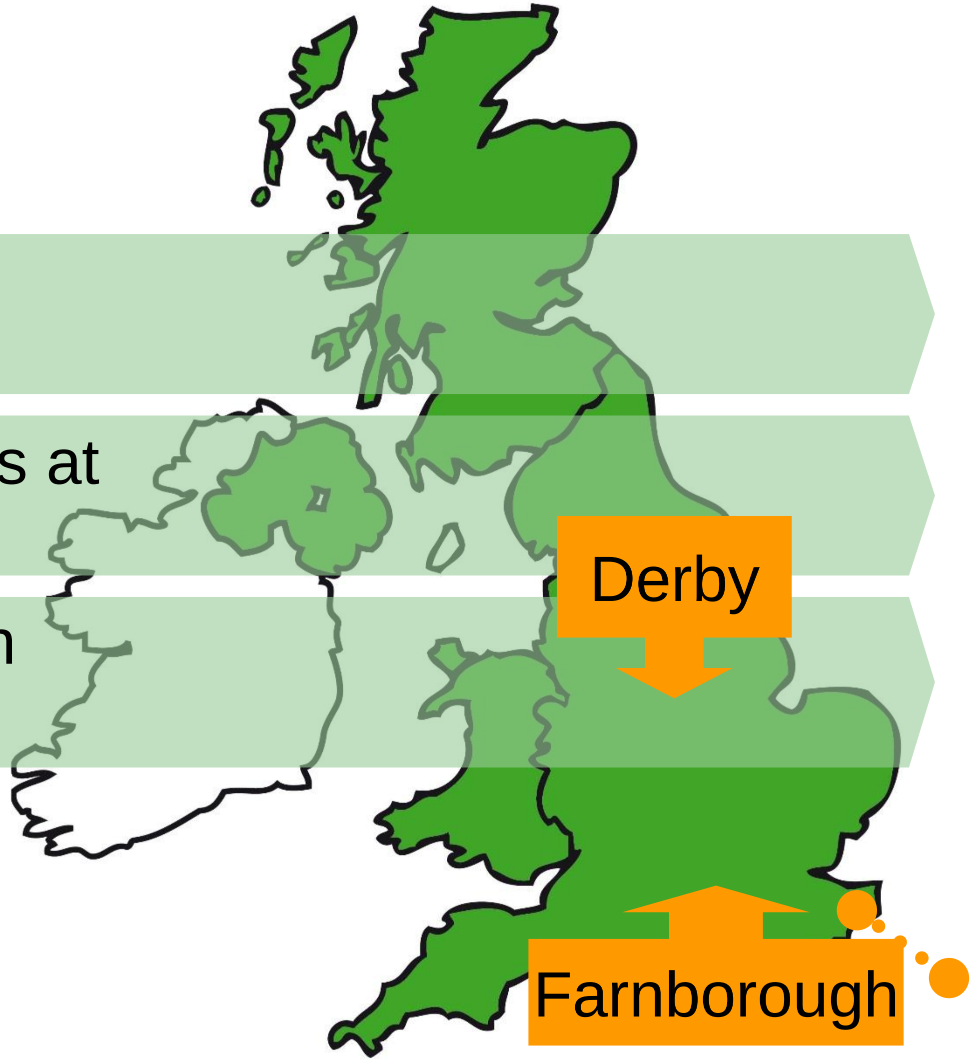


RAIB's geographical area and operation

Two operational centres

Vehicles and laboratories at both centres

On call roster has staff in place at both locations



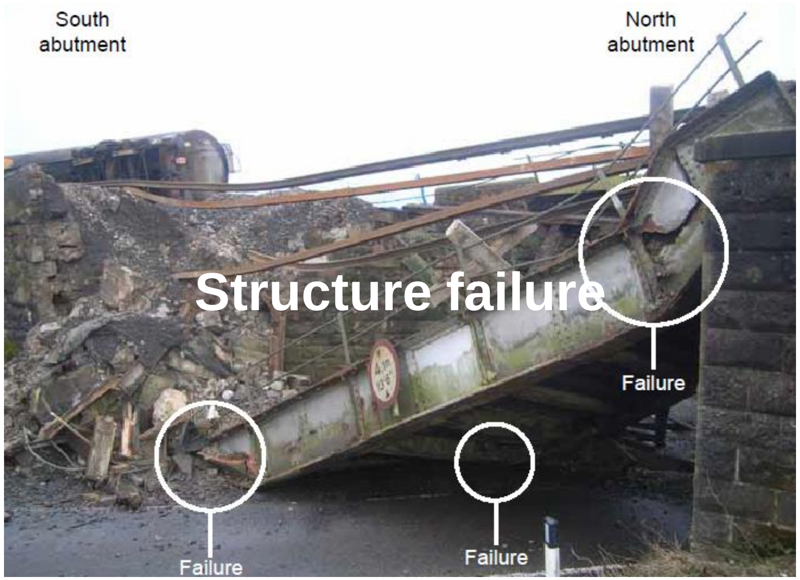
Update

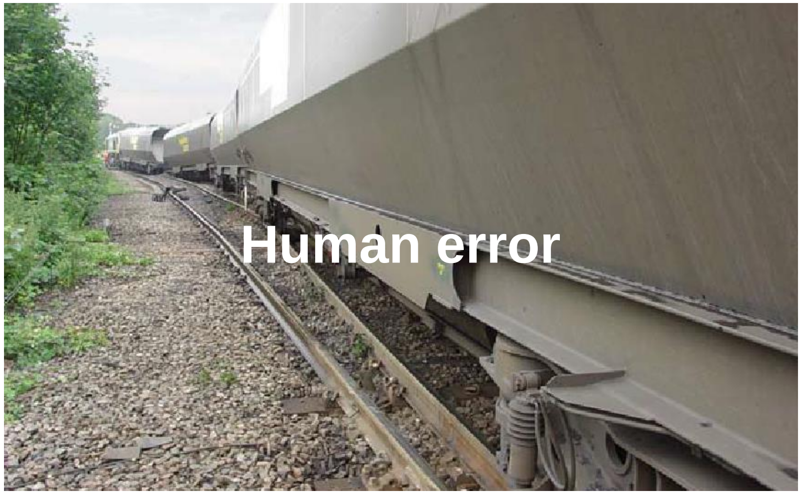
- All change at the RAIB
  - Chief Inspector left the Branch in June
  - New Chief Inspector to be recruited
  - Deputy Chief Inspector acting in the role in the interim
- Branch priorities
  - maintaining our reputation for high quality investigation
  - reviewing the way we engage with industry stakeholders
  - developing RAIB expertise and contacts in particular sectors (eg freight)
  - improving the way we communicate (to maximise safety benefit)

RAIB freight related investigations

- This presentation will review the RAIB’s freight related investigations published over recent years
- It will highlight some recurrent themes and important recommendations which include:
  - the interaction between track and freight trains (including the effect of their loads)
  - securing of containers on spigots
  - collisions between trains in engineering possessions or work sites

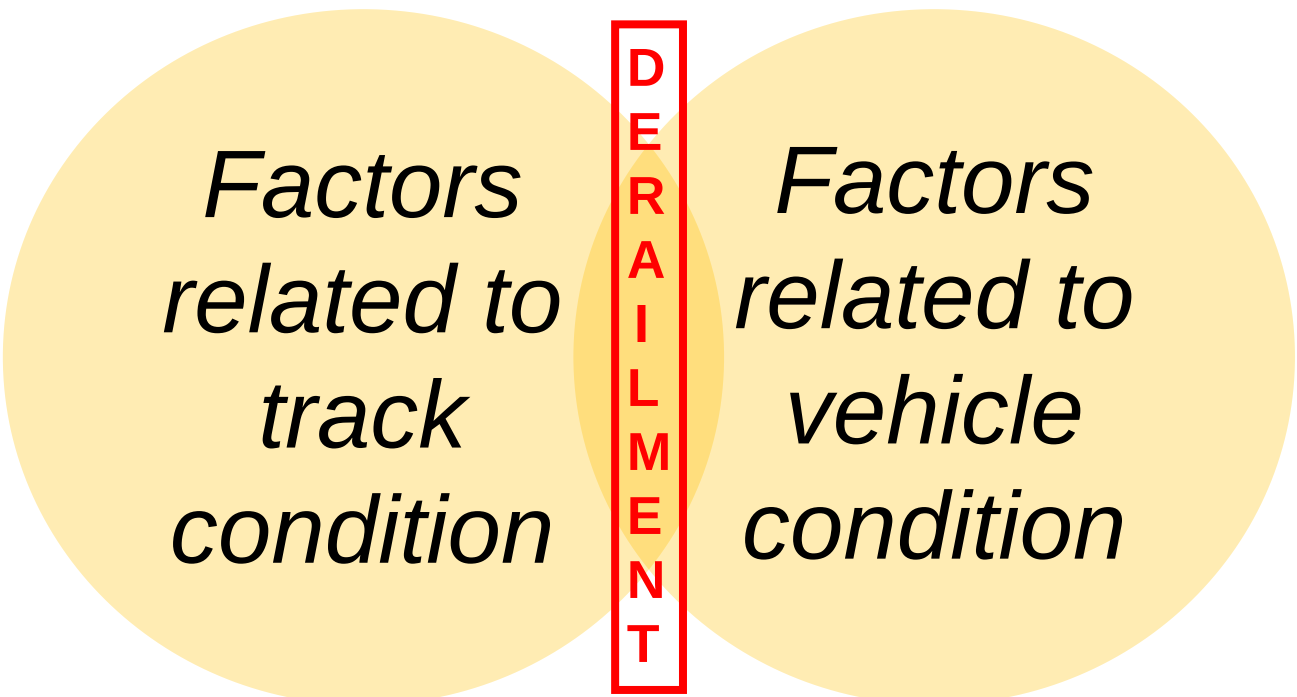
Freight train derailments can be due to many things…





Interaction between track & freight trains

- But about half of the freight train derailments that the RAIB has investigated involved…



Interaction between track & freight trains

- In the past 10 years, the RAIB has investigated 17 freight train derailments where the cause has been due to a combination of…

track factors

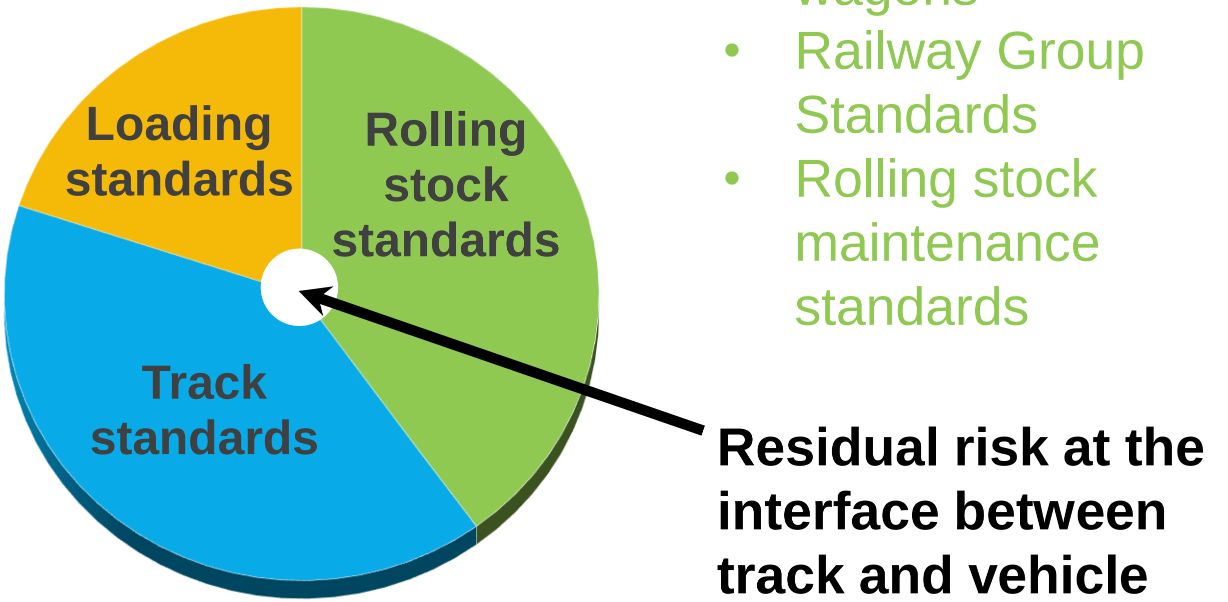
and vehicle factors

Do current standards cover all derailment risk at their interfaces?

- Standards for even distribution
- Legislation for loading & packing containers
- Standards governing distribution of weight on loaded trains

- TSI for infrastructure
- Railway Group Standards
- Network Rail track construction and maintenance standards

How the track / vehicle system interface risk is managed



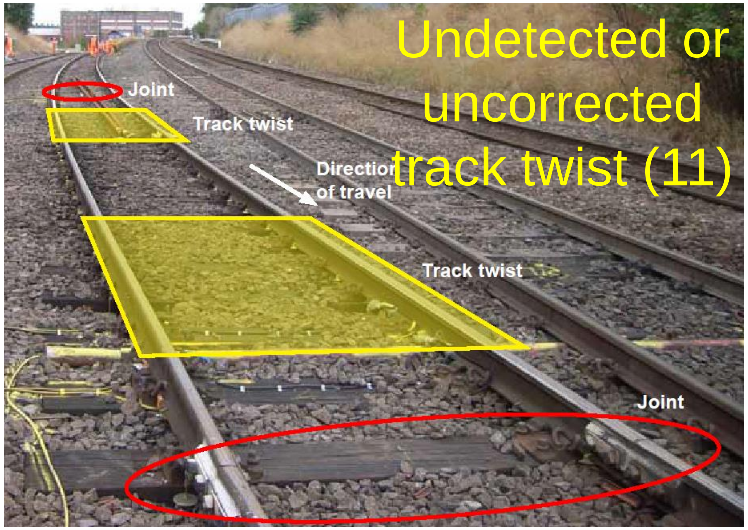
- TSI for freight wagons
- Railway Group Standards
- Rolling stock maintenance standards

Interaction between track & freight trains

- Risk of derailment can remain even when the track, vehicle and vehicle loading are compliant with mandated requirements
  - Research carried out in 1970s, which underpins some current standards, acknowledged that ensuring (absolute) derailment safety would mean ‘unjustifiably high costs of (vehicle) construction’. It therefore proposed finding a ‘compromise solution’
  - Industry argument that the risk of derailment remains acceptable while allowing for the residual risk at the interface between vehicle and track – this is based on belief that risk has already been reduced SFAIRP

Track condition factors

- In cases where both track and vehicle factors have been identified, the majority of track issues were:



- All of these track geometry faults required maintenance action but standards did not require trains to stop running
- Recommendations being implemented by Network Rail for effective detection and management of track geometry

Vehicle condition factors

- In cases where both track and vehicle factors have been identified, vehicle issues fell into the following categories:
  - Vehicle loading (5)
  - Suspension or wheelset (5)
  - Frame or bogie twist (4)
  - Ride performance (3)

Vehicle loading – Part or residual bulk loads

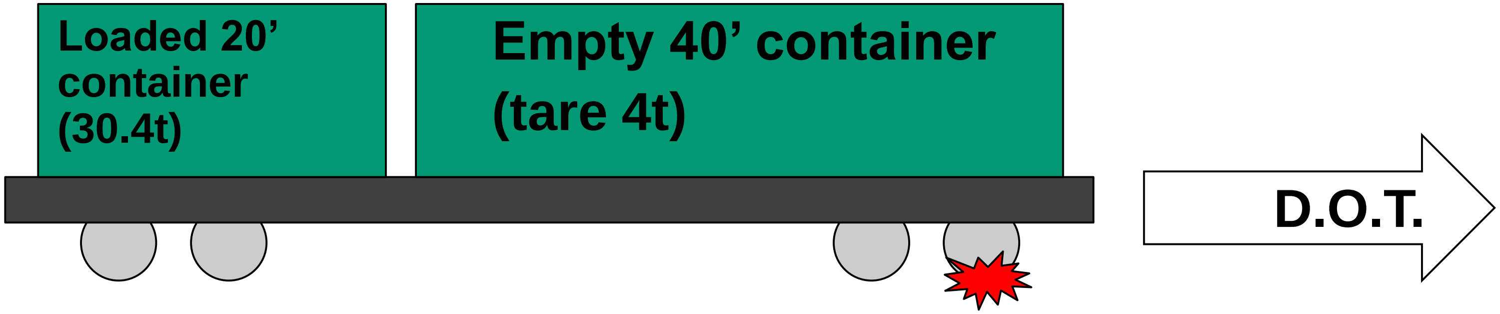
Santon: Coal laterally offset after wagon was loaded from a pad which affected load on leading right hand wheel.

Angerstein Junction: Unevenly distributed load of crushed stone left in hopper affected wheel loads.

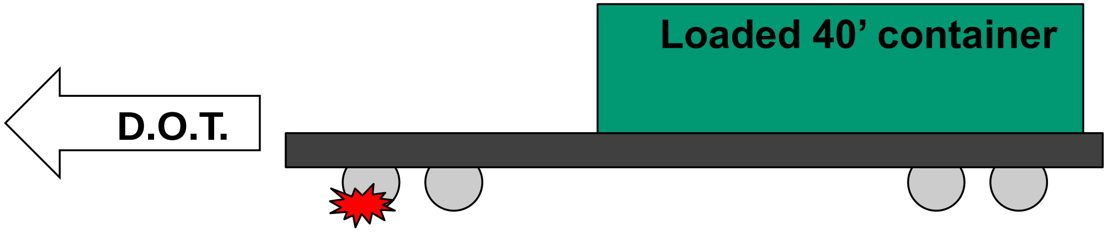
Vehicle loading - Containers

Duddeston: Leading wheelset derailed due wheel unloading. Load on wagon resulted in combination of lateral and longitudinal asymmetry

Sheet steel inside container was offset to left-hand side



Vehicle loading - Containers



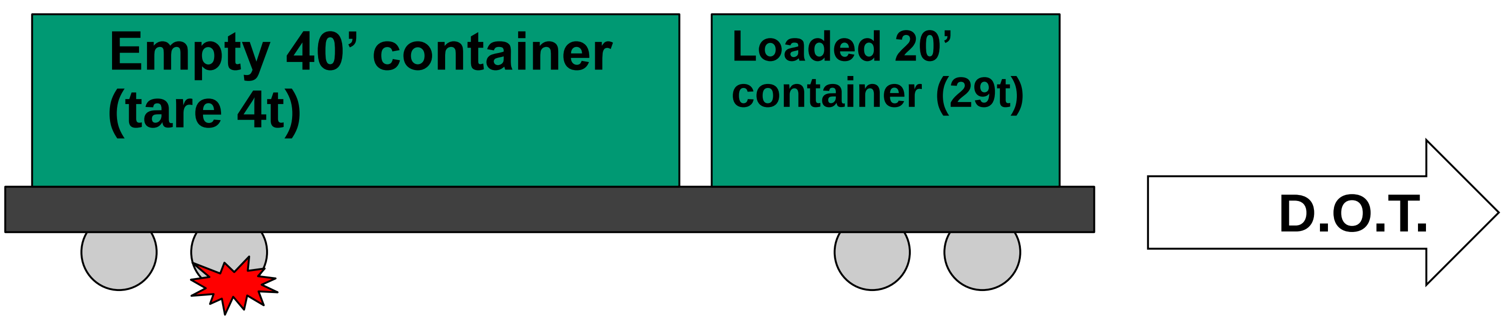
Reading West: Leading wheelset derailed due wheel unloading.
Load on wagon resulted in combination of lateral and longitudinal asymmetry.

Load of unsecured pallets had at some point shifted inside container

Vehicle loading - Containers

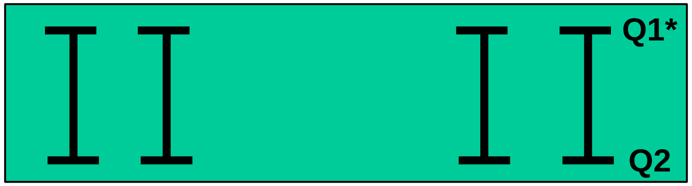
Primrose Hill / Camden Road:
Leading wheelset on trailing bogie derailed due wheel unloading.
Again containers loaded on wagon resulted in combination of lateral and longitudinal asymmetry.

Loaded container was carrying scrap electrical machines



Effect of offset load on derailment risk

Calculations show how the derailment risk due to wheel load imbalance is increased when there is a both a longitudinal and a lateral load offset



*at-risk wheel

DQ/Q = (Qave-Q1)/Qave

where: Qave = (Q1+Q2)/2

Typical effect

	Level track				Twisted track			
	Q1 (kN)	Q2 (kN)	Qave (kN)	DQ/Q	Q1 (kN)	Q2 (kN)	Qave (kN)	DQ/Q
No load offset	50	50	50	0%	35	65	50	30%
Longitudinal offset load	35	35	35	0%	20	50	35	43%
Lateral offset load	35	65	50	30%	20	80	50	60%
Lateral + Longitudinal load offset	20	50	35	43%	5	65	35	86%

Key issues with vehicle loads

Weight distribution of the wagon's load - lateral asymmetry exacerbated by the longitudinal asymmetry

- Is the risk understood?
- Are there reasonable practicable measures that can be taken:
  - to prevent uneven or insecure loading at source (eg at shippers)?
  - to detect dangerous levels of load asymmetry and prevent it entering the railway network?
- Can the potential impact of lateral asymmetry be reduced by controlling the extent of longitudinal asymmetry?

Why re-examine this issue now?

- The work of the RAIB shows that uneven loading of wagons continues to be a major factor in the cause of derailments
- It is possible likely that the 'historic norm' will be influenced by a number of changes significant changes such as
  - Growth in the numbers of 40' containers
  - Increase in max. weight of 20' containers since 1994
  - Introduction of higher containers
  - Changes to the ways that containers are allocated to wagons
  - Torsionally stiffer underframes may be making modern container wagons more prone to long-base track twists

Vehicle load affecting wheel unloading

- Camden Road recommendation encourages rail industry to see this as a system issue:

> *Freightliner and Network Rail should jointly research the factors that may increase the probability of derailment when container wagons are asymmetrically loaded, including:*
>
> - *sensitivity to combinations of longitudinal and lateral offsets in loads that can reasonably be encountered in service;*
> - *the effect of multiple track twist faults over various distances*
>
> *and work with other industry stakeholders to identify, evaluate and promote adoption of any additional reasonably practicable mitigations capable of reducing the risk from asymmetric loading of wagons.*

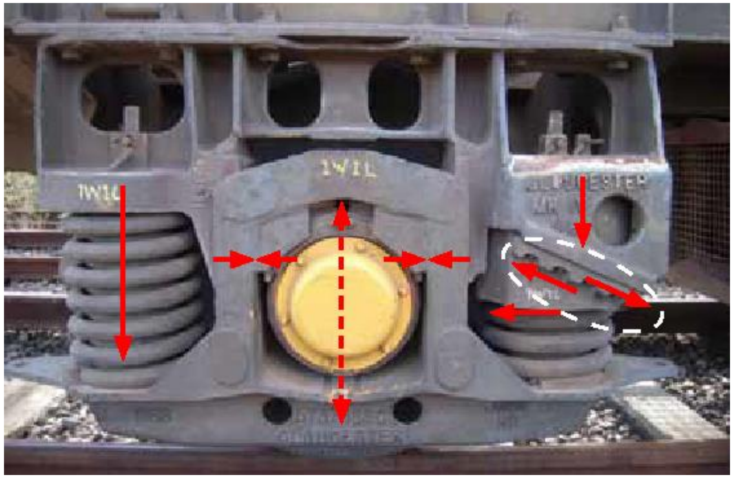
- Encouraged by the ORR, a cross industry group met earlier in 2015 to review freight train derailment risk

Uneven and insecure loading of containers is an issue that affects all parts of the freight sector – are there further opportunities for working across the sector?

Suspension or wheelset – Locking-up

Ely Dock Junction: Leading right hand suspension locked-up causing this wheel to unload and flange climb.

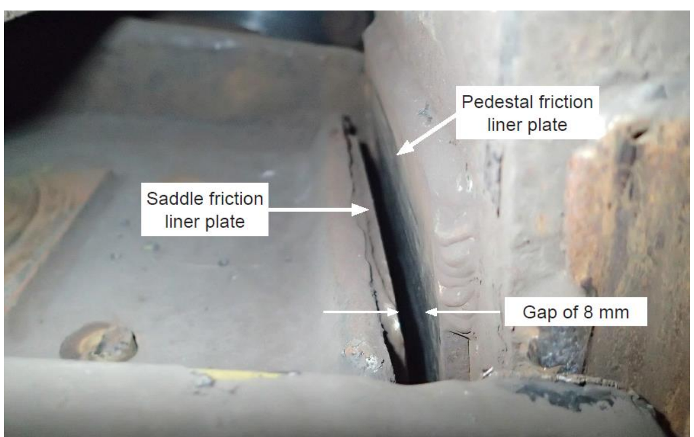
Bordesley Junction: Trailing left hand suspension locked-up causing leading right hand wheel to unload and flange climb.

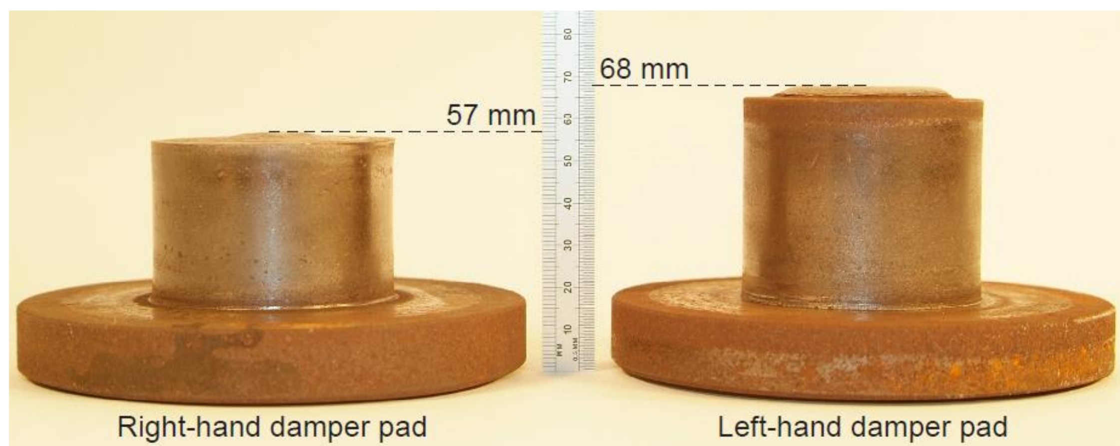


Gloucester pedestal suspension prone to locking-up when components are worn – modifications recommended.

Suspension or wheelset – Un-damped

Heworth: Leading left hand wheel derailed due to an un-damped Gloucester pedestal suspension on leading right hand wheel. Worn components were found within this suspension. Recommendation to mitigate risk of degraded ride performance due to worn suspension components.





Frame or bogie twist affecting wheel load

Ely Dock Junction and Wigan: Wagons had frame twist with incorrect packing that worsened the amount of twist.

King Edward Bridge Junction: Wagon had a twisted frame.

Angerstein Junction: Wagon had a twisted bogie

Key issues with frame or bogie twist

Frame/bogie twist

- How prevalent is frame twist in existing fleets of wagons and do we understand the associated risk posed by twisted wagon frames?
- How prevalent are twisted bogies (and/or incorrect packing) and is this allowed for in our current understanding of derailment risk?

Use of track side equipment (eg GOTCHA)

- Can we use such equipment to identify individual wagons with uneven wheel loads due to defects such as:
  - abnormal levels of frame twist?
  - excessive bogie twist or suspension defects?

Ride performance – frame stiffness

Primrose Hill / Camden Road:
Possible factor related to high torsional stiffness of the FEA wagon underframe, particularly when partially loaded. This wagon type has a central spine. It is also the same type that derailed at Duddeston.

Ride performance – partial load

Marks Tey: Container flat wagon (type FSA/FTA) derailed on a series of dips in the track. Wagon type did not meet vertical ride performance requirements in standards when partially loaded.

Gloucester: New design of container flat wagon (type IDA) derailed on a series of dips in the track. Wagon did not meet vertical ride performance requirements in standards when partially loaded.

Key issues with ride performance

Standards

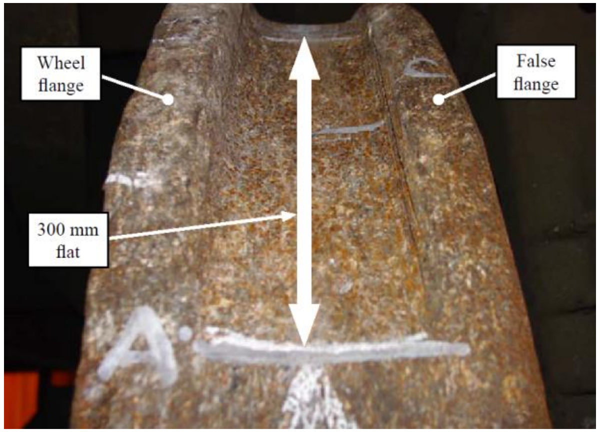
- How are the requirements for ride performance in the TSI for Freight Wagons and supporting standards being applied to the design of freight wagons? How well understood are these requirements?
- Is vertical ride performance adequately assessed?
- Do these requirements mitigate the risk of derailment when operating wagons on Network Rail's infrastructure?

Testing a range of loading conditions

- What strategy can be applied to ensure that the ride performance is adequately assessed?
  - Loading conditions, particularly partial loading?
  - On-track testing versus computer modelling?

Train preparation and stabling

- In the past 10 years, the RAIB has investigated a number of accidents and incidents where train preparation or stabling has featured…



October 2005, Hatherley. Handbrake left on and wheels developed false flanges. Wheelset then derailed on trailing points.

Train preparation and stabling

February 2006, Basford Hall.
Freight train was dispatched from yard with the wrong wagons in the consist. These wagons were carrying loads that were unsecured.

February 2010, Romford.
Freight train was dispatched from yard with bottom doors on wagon not fully closed. Ballast then fell from the wagon and struck passengers waiting on a platform.

Train preparation and stabling

December 2008, Basingstoke.
Train dispatched with 9’ 6” container out of gauge for the route the train was due to take. During its journey the container struck the canopy at Basingstoke station.

January 2015, Moston.
Wagon was out of gauge due to a spigot that was not stowed. This was not noticed when the train was prepared. Spigot collided with platform and dislodged coping stones which following train struck.

Train preparation and stabling

May 2010, Ashburys.
Handbrakes were applied when train was stabled but these were ineffective. Five wagons ran away and only stopped when two derailed on trap points.
Recommended that pull test is carried out when stabling to check effectiveness of applied handbrakes.

Key issues for train preparation & stabling

Train preparation

- Are train preparation measures adequate and how to ensure that are they being carried out correctly?
- How to maintain staff competency for different wagon types and loading configurations?
- How to make sure the visibility of un-stowed equipment or position indicators is sufficient? Paint? Lighting adequate?

Handbrakes

- What measures are needed to check trains are effectively secured when they are stabled?
- How to ensure that handbrakes are not left applied when a train enters into service?
- What are the advantages and disadvantages of using scotches rather than handbrakes?

Securing of containers on spigots

- Loss of loads has been particularly relevant for empty containers carried on spigots

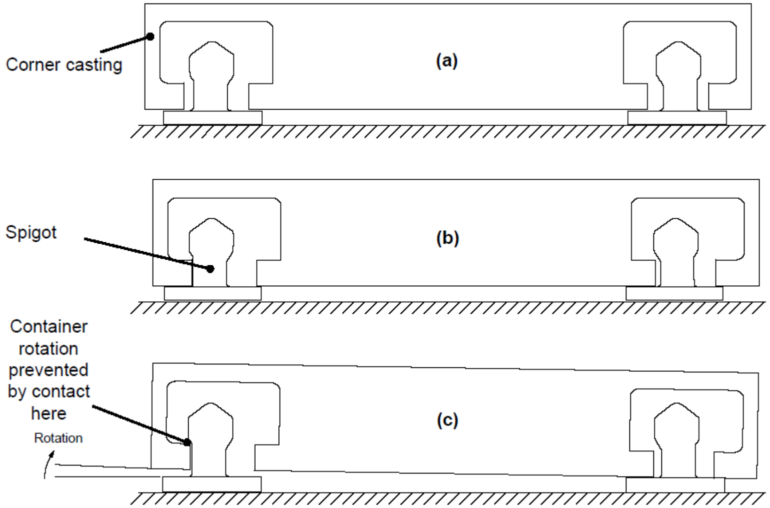
March 2008, Cheddington.
Two empty containers were blown off a freight train.

March 2008, Hardendale.
Five empty containers were blown off a freight train.

In both cases, the containers blocked running lines and damaged infrastructure.

Securing of containers on spigots

- In both cases, the empty containers were sat, unsecured, on top of fold-down spigots on FEA wagons
- The overturning and detachment of the empty containers was due to:
  - aerodynamic forces from a combination of high cross winds and train speeds
  - the FEA wagon's fold-down spigots not providing overturning retention because they had not been designed in accordance with UIC standards



Securing of containers on spigots

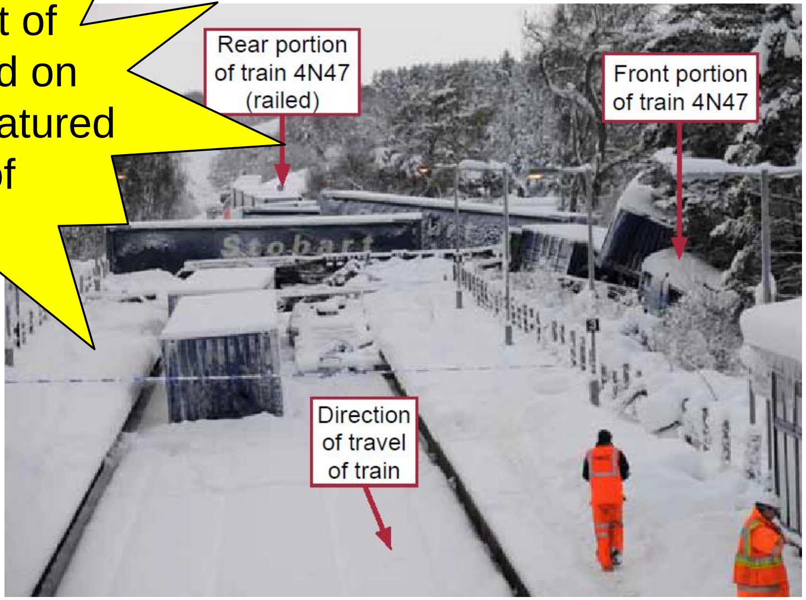
- RAIB made 10 recommendations to address the issues found
- However, in March 2015, there were two further occasions when an unsecured, empty container was blown from an FEA wagon

March 2015, Scout Green, Cumbria.

March 2015, Deeping St Nicholas, Lincolnshire.

Securing of containers on spigots

The detachment of containers carried on spigots has also featured in a number of derailments



Key issues for securing containers on spigots

- Is design guidance for spigots, particularly for fold-down spigots, sufficient to ensure overturning retention is provided?
- How to get the vehicle approvals process to consider this issue when assessing new or modified wagons?
- How to get the lessons learnt related to spigots into European standards for future designs of wagon?
- On existing wagons fleets that have spigots which do not meet the required standards:
  - How can the risk of carrying empty containers be best managed when high winds are forecast?
  - What special measures need to be taken (eg running at lower speed or pinning containers down)?
  - How to ensure staff will apply these special measures?

Collisions in possessions & work sites

- In the past 10 years, the RAIB has investigated 5 collisions within possessions or work sites…

October 2006, Badminton.
Tamper collided with a ballast regulator while travelling in a work site. Tamper driver did not control speed to be able to stop in time.

April 2008, Leigh-on-Sea.
Train collided with rear of a train ahead of it while travelling in a work site. Driver unsure of stopping location and going too fast to stop.

Collisions in possessions & work sites

September 2012, Arley.
Stone blower collided with a ballast regulator while travelling in a work site. Stone blower driver unaware regulator had stopped and was going too fast to stop.

January 2014, Kitchen Hill.
Train collided with rear of a train ahead of it while travelling in a work site. Driver thought train ahead was in different place and was going too fast to stop.

Collisions in possessions & work sites

August 2015, Logan.
Train collided with rear of a train ahead of it while travelling in a work site.
Investigation is ongoing but emerging findings are driver's understanding of location of train ahead and speed travelling at are likely to be issues.

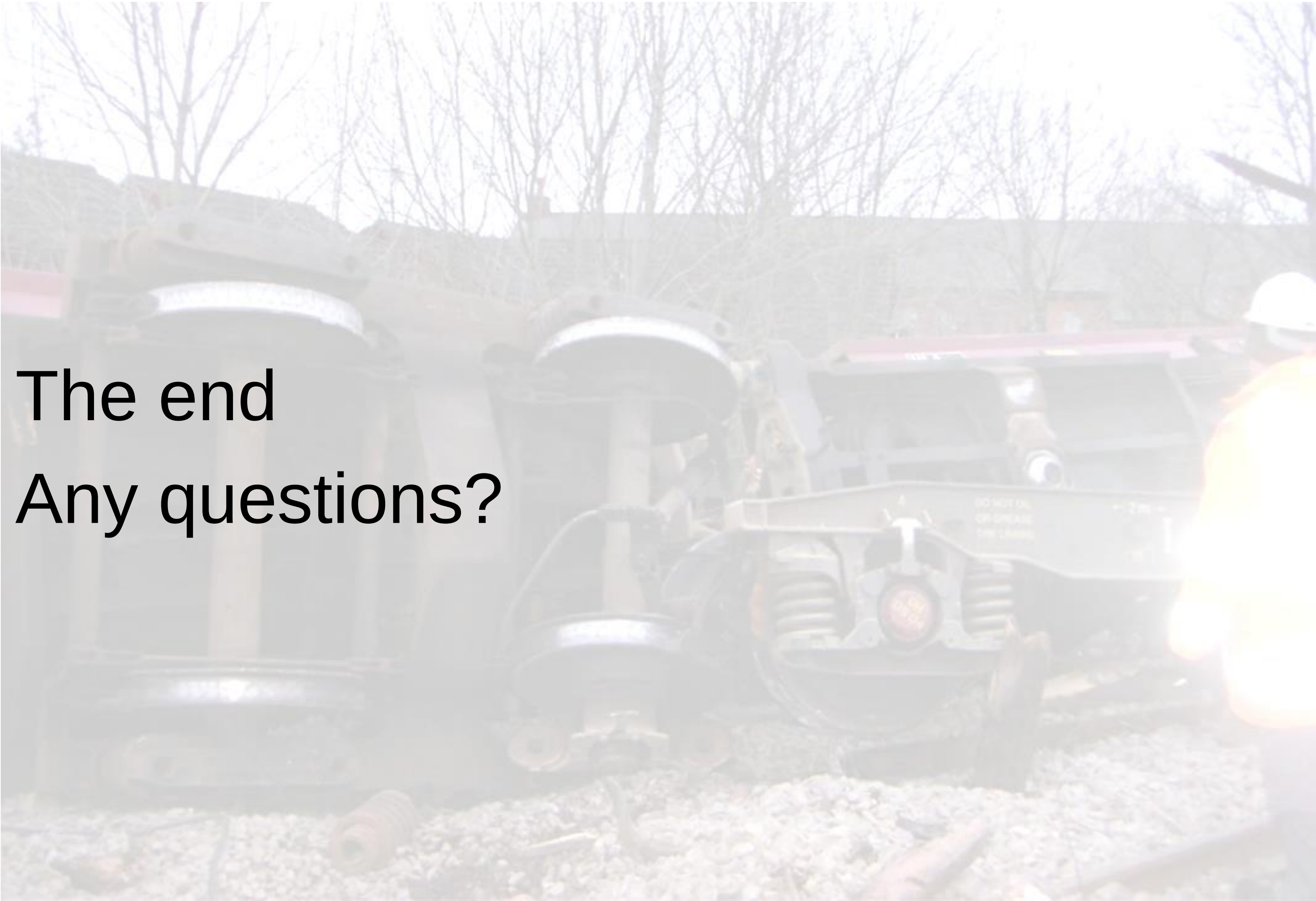
Key issues with trains in possessions and work sites

Communication

- How to ensure a train driver travelling within a work site knows exactly where to go to?
- How is this information passed over and recorded?

Driving on sight within works sites

- How does a train driver adjust from driving in response to signals to then driving by sight?
- How does a train driver judge his braking point to unfamiliar stopping points, particularly in goods timings?
- How is a train driver's competence for driving on sight within a work site assessed?
- Should train drivers have to drive on sight at 5 mph for long distances within work sites?



The end

Any questions?