NWTF

Unlocking future high-speed rail freight transportation capability through aerodynamics

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RAIL SAFETY AND STANDARDS BOARD

‘Superfast Freight’: aerodynamic assessments and mitigations

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Project background

A new generation of freight locos and wagons have started to enter service on the GB network.

Many have the capability to haul freight at speeds beyond what has been traditionally possible. Yet, for freight services on the GB network, an upper limit of 75mph remains in place.

Industry-led desire to unlock freight haulage at speeds beyond the 75mph.

The ‘superfast’ freight concept relates to enabling class 4 freight services to travel at speeds above the current 75mph limit. The benefits of unlocking higher speeds for freight are significant.

This will allow freight to fit in more seamlessly between passenger services, introducing a step-change, in freight operation, performance and opening up new rail freight markets.


MIND THE GAP

Project background

Risks associated with aerodynamic effects caused by moving trains are managed through industry standards and guidance. Their content is based on empirical evidence gathered from laboratory and field testing. In many cases, testing parameters relate to maximum permitted speeds allowable on the network.

However, there is very limited data and knowledge for freight aerodynamics, which has meant it has not been possible to permit speed increases.

What next?

Clear that more data is required in key areas to support the removal of barriers to superfast freight.

This will be conducted through practical studies and risk analysis.

Project objectives

This project **aims to develop the required knowledge of freight train aerodynamics and support the removal of aerodynamic barriers to high-speed freight**.

To achieve this aim, the following objectives have been developed:

1) Conduct a long-term full-scale test to aerodynamically characterise current freight trains with a view to exploring existing barriers to high-speed freight.
2) Develop a foundation of aerodynamic knowledge and data for specifically identified freight train types for high-speed freight utilising physical modelling techniques.
3) Develop industry guidance for on the removal/mitigation of aerodynamic barriers to high-speed freight train operations.

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Physical model testing

Physical model testing

TRAIN rig is a unique moving model test facility, which has the capability to accurately model the relative motion between a moving vehicle and the ground/infrastructure.

Physical modelling testing to understand aerodynamic characteristics of new freight rolling stock.

A range of measurements conducted to measure aerodynamic flow velocities and pressures in relation to the approaches in the NTSN and BSI standards.

Physical model testing

Physical model testing

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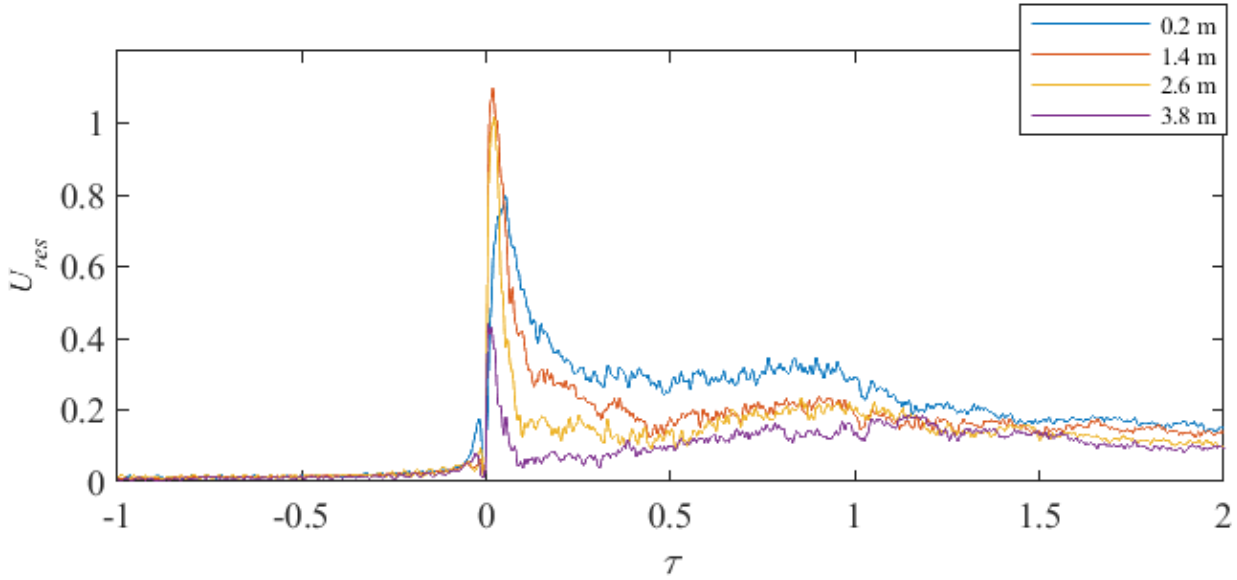
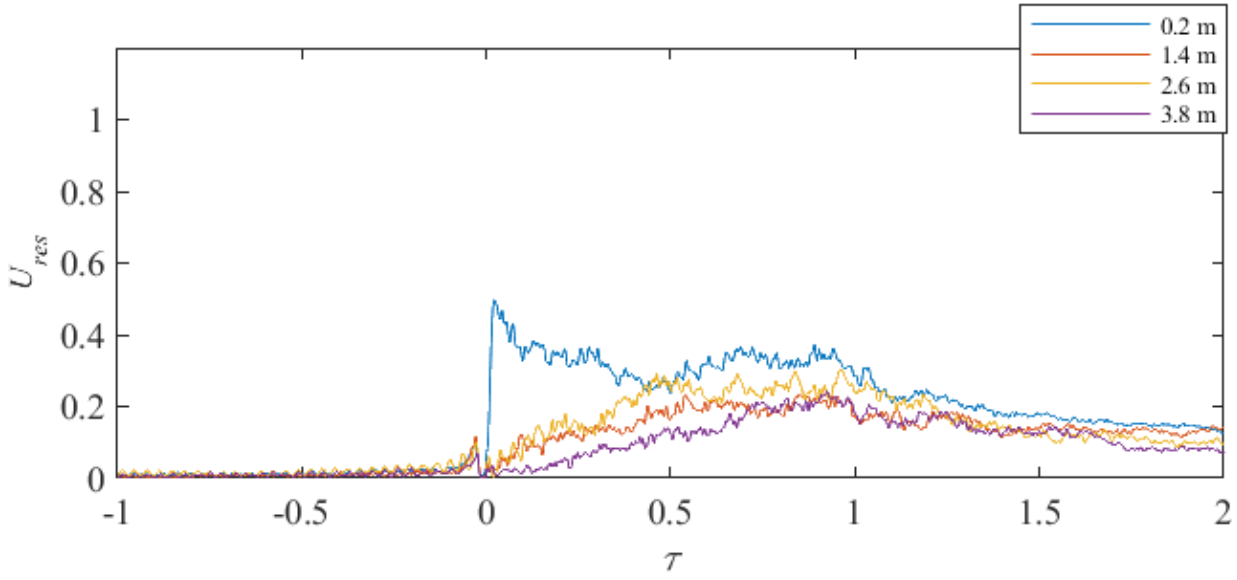
Physical model testing results

JPA tanker wagons – height comparison

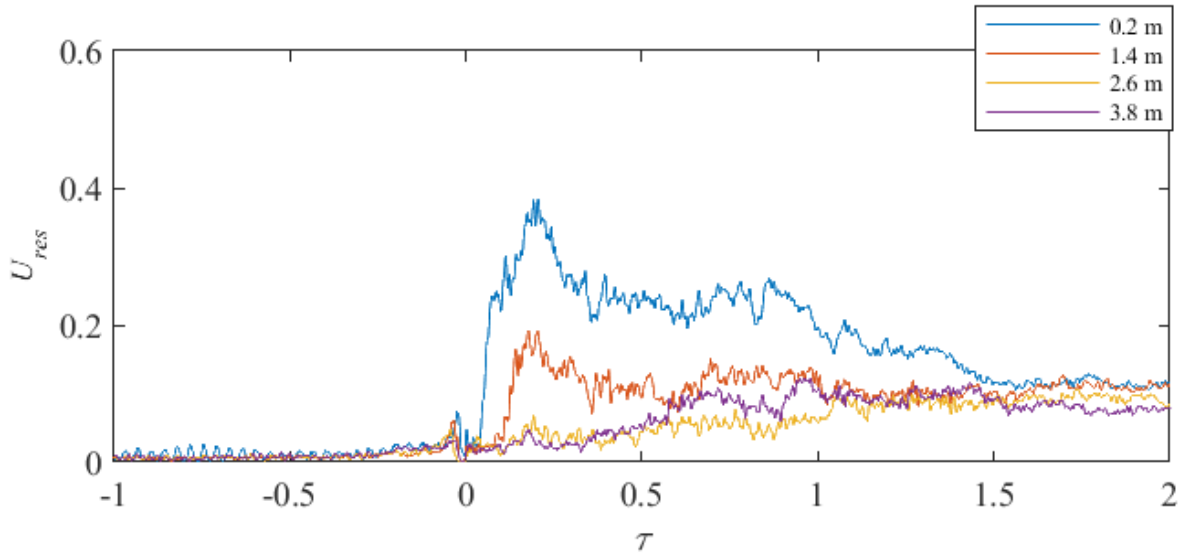


a) Class 66 + JPA

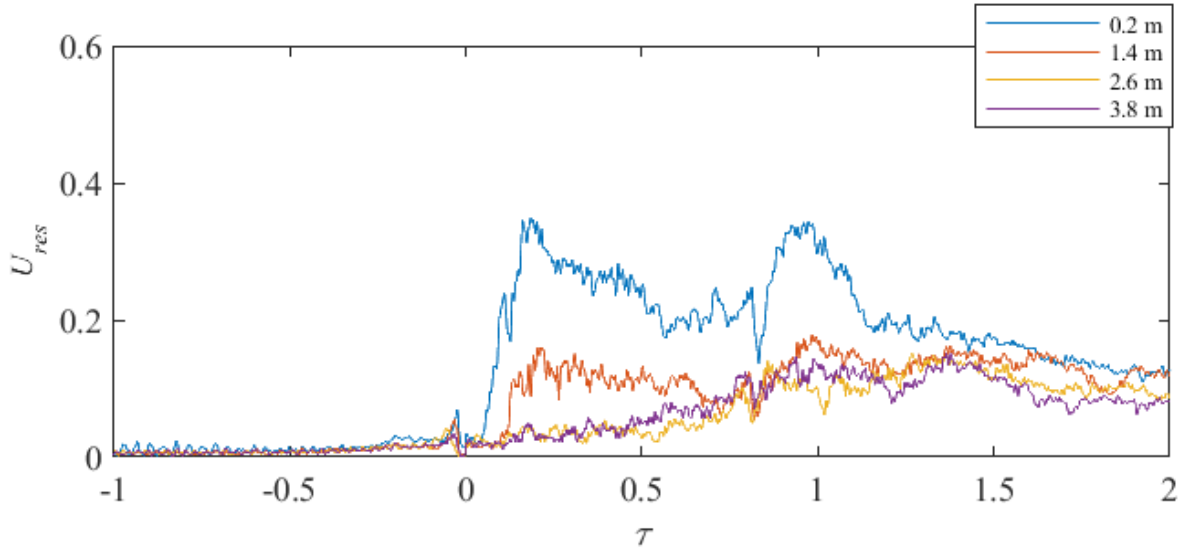


b) Class 93 + JPA

FWA intermodal wagons – height comparison

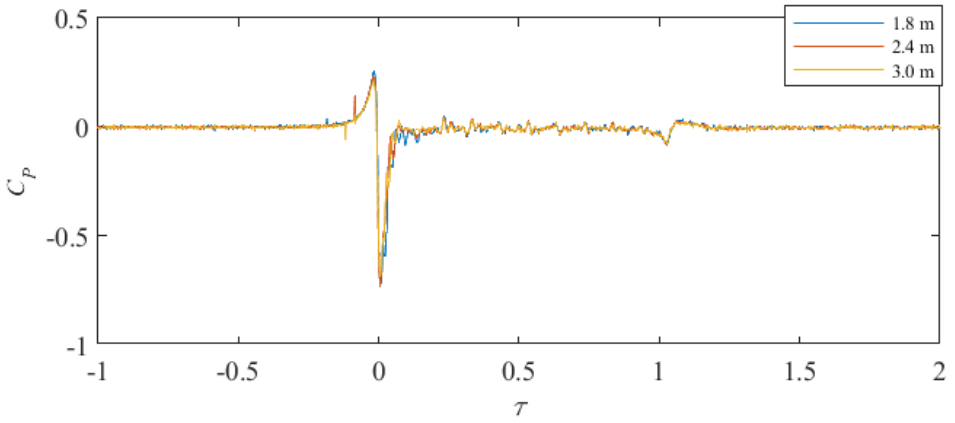


a) Class 93 + FWA fully loaded

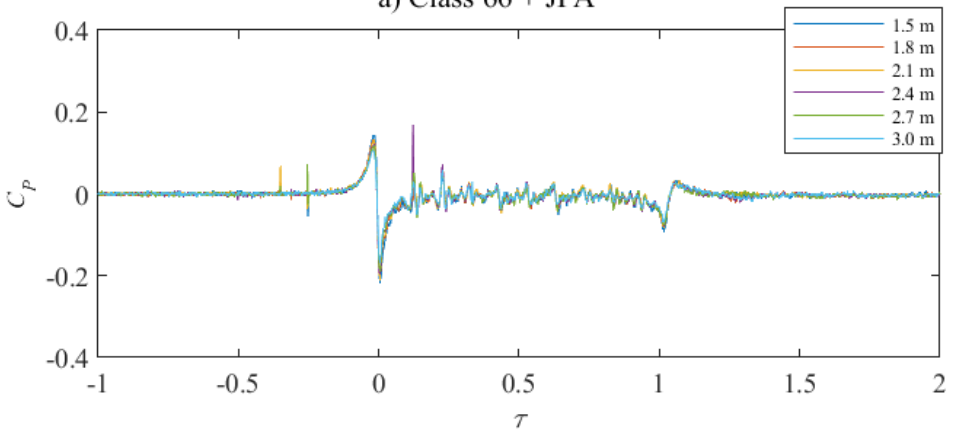


b) Class 93 + FWA partially loaded

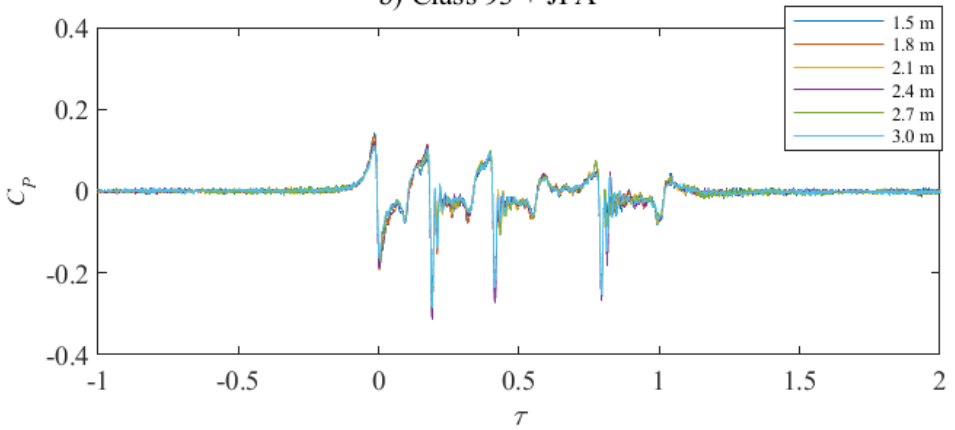
JPA and FWA wagons – height comparison



a) Class 66 + JPA



b) Class 93 + JPA



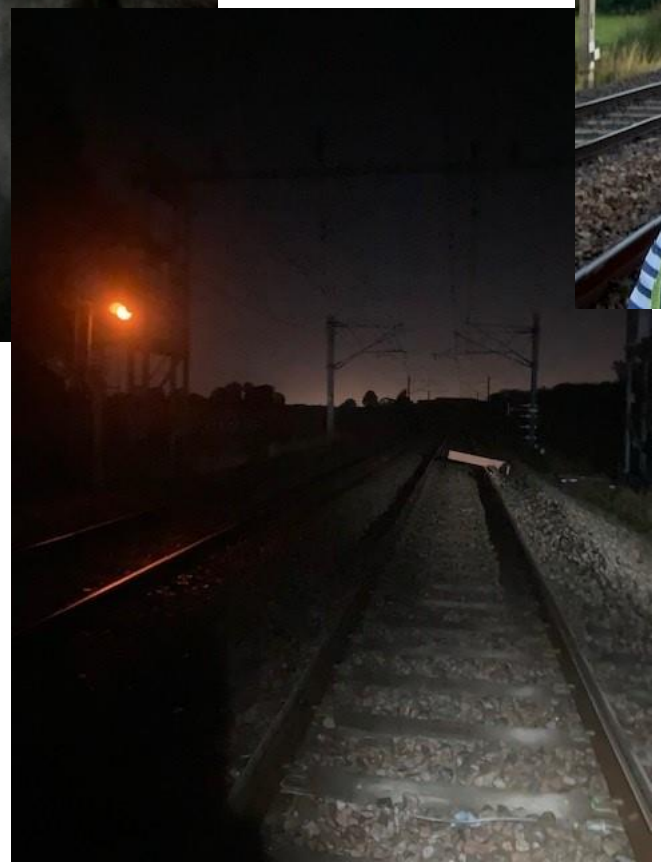
c) Class 93 + FWA partially loaded case 3

Standards - slipstream velocities Platform

ID	Height above platform (m)	Mean value $\overline{u_{max}}$ (m/s)	Standard deviation σ (m/s)	$u_{2\sigma}$ at 75 mph (m/s)	Dimen-sionless value	$u_{2\sigma}$ at 90 mph (m/s)	$u_{2\sigma}$ at 100 mph (m/s)	$u_{2\sigma}$ at 110 mph (m/s)
Class 66	1.2	7.78	1.76	11.30	0.34	13.57	15.08	16.59
Class 93	1.2	3.00	1.11	5.22	0.16	6.27	6.97	7.66
Class 66 + JPA	1.2	8.64	1.47	11.58	0.35	13.90	15.45	16.99
Class 93 + JPA	1.2	5.97	0.80	7.58	0.23	9.11	10.12	11.13
Class 93 + FWA fully loaded case 1	1.2	7.90	1.47	10.83	0.32	13.00	14.45	15.90
Class 93 + FWA partially loaded case 2	1.2	10.20	1.07	12.34	0.37	14.82	16.46	18.11
Class 93 + FWA partially loaded case 3	1.2	10.99	1.66	14.31	0.43	17.19	19.09	21.01
Class 93 + FWA unloaded case 4	1.2	8.70	1.30	11.29	0.34	13.56	15.06	16.57

Conclusions to date

- Peak magnitudes created by the Class 66 for both slipstream and pressure transient considerations exceed those for the Class 93, primarily due to the non-aerodynamically shaped bluff nature of this locomotive.
- Results in relation to requirement limits for slipstream velocities illustrate that for intermodal freight considerations only fully loaded or unloaded cases can be considered further for adoption of higher freight speeds.
- Comparison of trackside results in relation to measurements made at platform positions suggest that a platform measurement must be made for freight trains to ensure reasonable slipstream velocity magnitudes are observed from a platform safety perspective.
- Class 93 locomotive hauled trains all fall within the specified requirement limits for both slipstream and pressure transient effects up to 90 mph, presenting a potential route to increasing freight train speeds.



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QUESTIONS?

Thank you for listening