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Original Citation

Bevan, Adam, Jaiswal, Jay and Tucker, Gareth J. (2017) Deployment of Available Rail Steels to Reduce Life Cycle Costs. In: 6th Rail Research UK Association Annual Conference, 16th November 2017, London.

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Deployment of Available Rail Steels to Reduce Life Cycle Costs

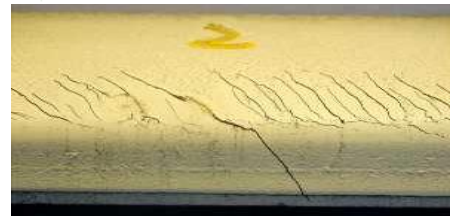
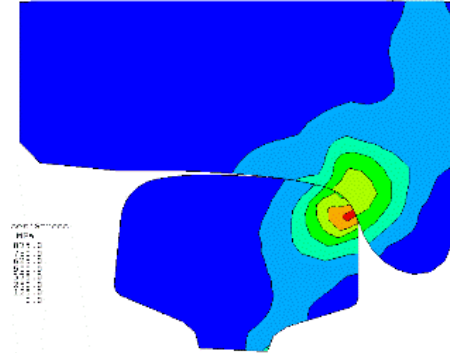
University of Huddersfield, Institute of Railway Research
Adam Bevan, Jay Jaiswal & Gareth Tucker

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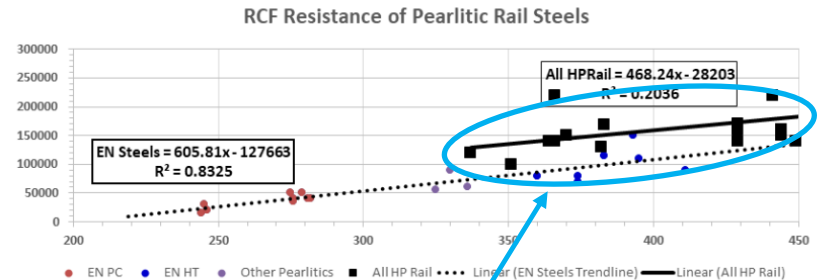
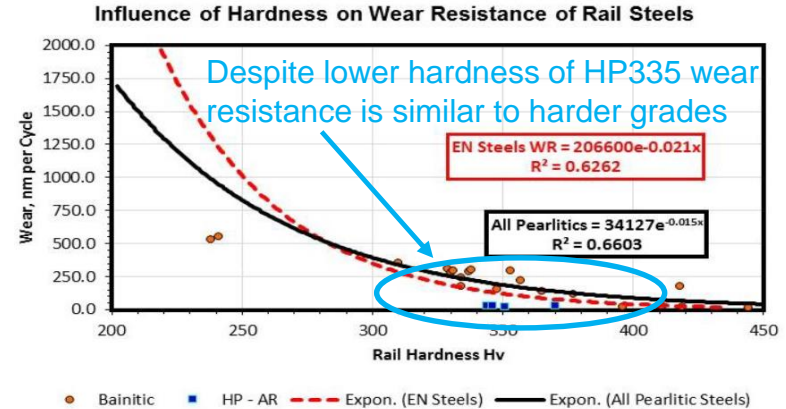
Background

- Previous research has focused on investigating vehicle-track characteristics to reduce wheel-rail forces
 - Less effort has been spent on increasing the materials resistance to the imposed forces
- EN13674-1 defines rail steels with varying hardness, but it is the microstructure that governs damage resistance
 - Rail manufacturers have also recently developed new steels which provide improved resistance to wear and RCF (e.g. HP335)
- Further research is required to understand the reasons for these improvements and to provide guidance on the optimum deployment of rail steels



Performance of rail steels

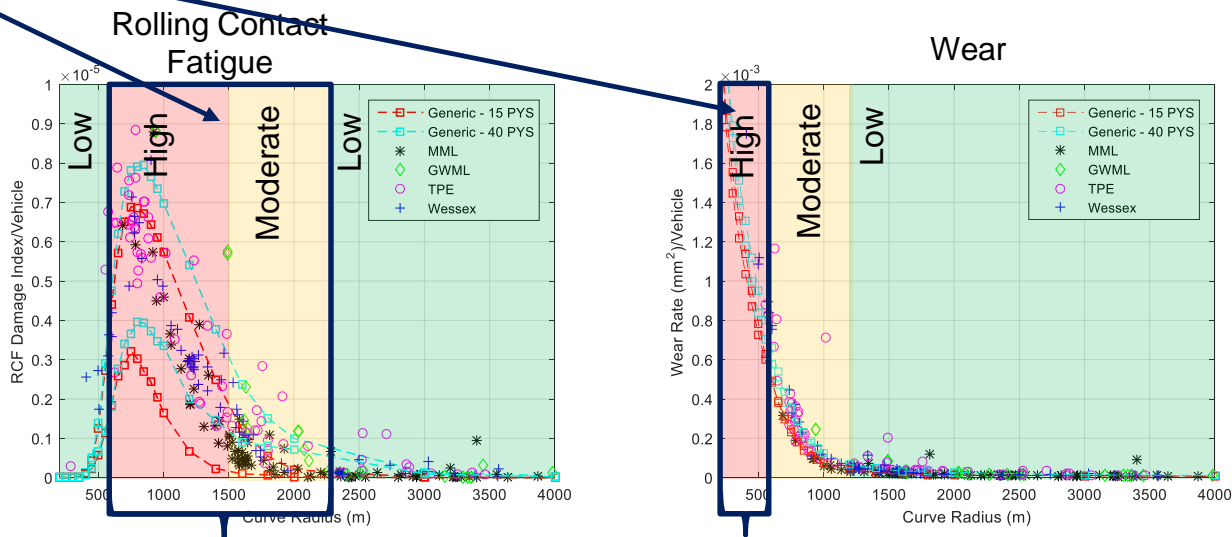
- EN13674-1 lists 9 rail steel grades in two categories:
 - **As-rolled**: derive their strength and hardness from the steel composition
 - **Heat treated**: derive their strength from steel composition and the heat treatment process
- Experimental testing undertaken to understand the performance of current rail steels



HP rail shows greater RCF resistance than EN grades with equivalent hardness

Application of HP rail steels

To reduce whole life costs, premium rail steels should be considered for use in critical curves where RCF or wear causes the premature replacement of the rail



Used in moderate curves to preserve the ground rail profile and increase the resistance to RCF

Used in in tight radius curves to increase resistance to wear

Microstructural characterisation

- *Metallurgical examination* used to identify contribution of composition and microstructure parameters on wear and RCF resistance

Hardness of hypereutectoid steels through accelerated cooling

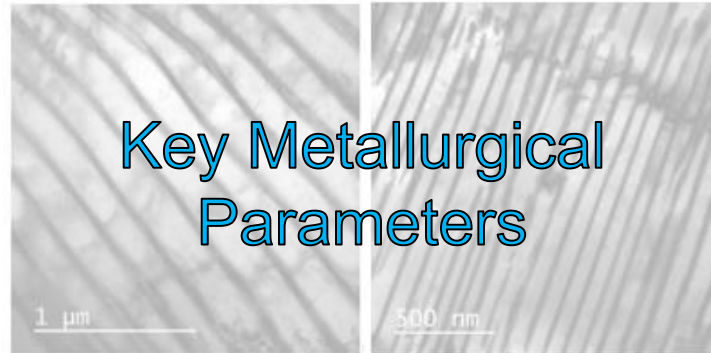
Finer interlamellar spacing considered to have a second order influence

Vanadium alloyed steels showed better resistance to plastic deformation

Influence of fragmentation of pearlitic cementite lamellae

Steels alloyed with Silicon better resist dissolution of cementite and thereby improved RCF resistance

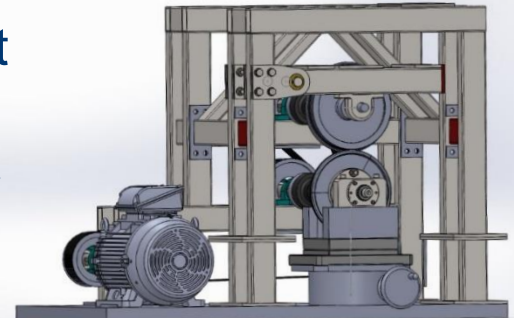
Alloying with manganese considered beneficial for RCF resistance



Further data required to investigate volume fraction of cementite

Conclusions

- Project has made some *key breakthroughs* in understanding the influence of *alloying elements* and *hardness* on *degradation of rail steel microstructures*
- *Damage susceptibility* of track sections has been assessed to formulate guidelines for deployment of rail steels type
- *Laboratory twin-disc facility* has been developed for future testing of rail steels under more realistic contact conditions
- Further work proposed to undertake *controlled testing* and microstructural assessment to cover more rail steels



Acknowledgements

- Research financed under EPSRC/DfT/RSSB grant EP/M023303/1:
 - ‘Designing steel composition and microstructure to better resist degradation during wheel-rail contact’
- In collaboration with:
 - University of Cambridge
 - University of Leeds
 - Cranfield University
 - British Steel
 - Network Rail

