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Institute of Railway Research

Deployment of Available Rail Steels to Reduce Life Cycle Costs

University of Huddersfield, Institute of Railway Research
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Background

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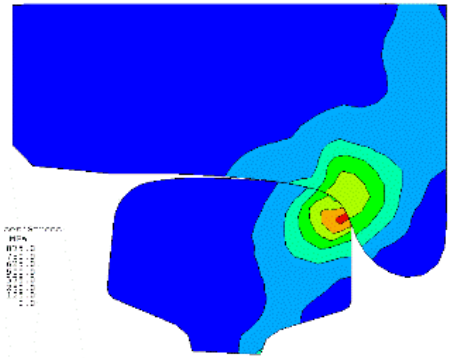
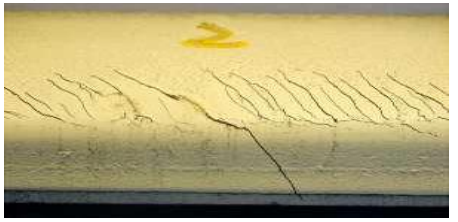
- Previous research has focused on investigating vehicle-track characteristics to reduce wheel-rail forces
  - Less effort has been spent on increasing the *materials resistance* to the *imposed forces*
- EN13674-1 defines rail steels with varying hardness, but it is the microstructure that governs damage 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

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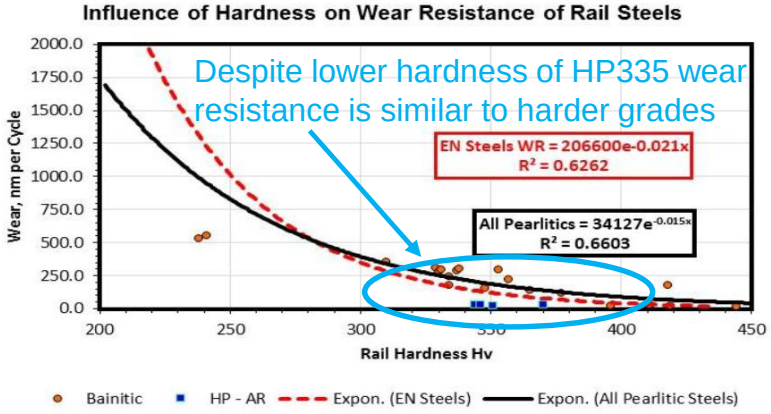
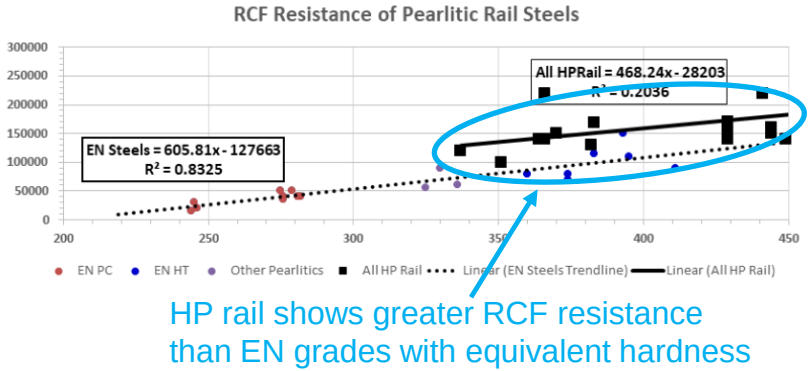
- EN13674-1 lists 9 rail steel grades in two categories:
  - ***As-rolled***: derive their strength and hardness from the steel composition
  - ***Heat treated***: derive their strength from steel composition and the heat treatment process
- Experimental testing undertaken to understand the performance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





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

Application of HP rail steels

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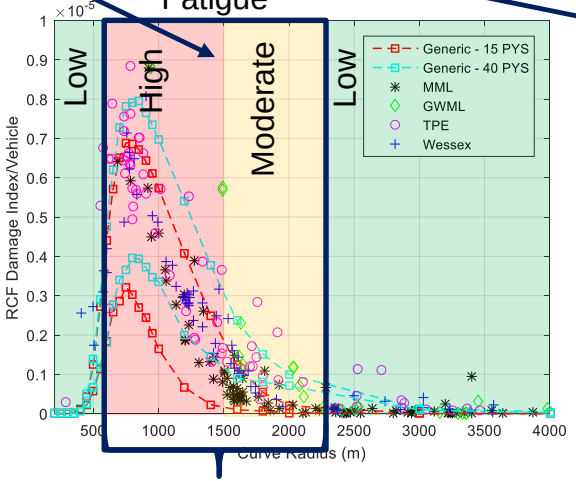
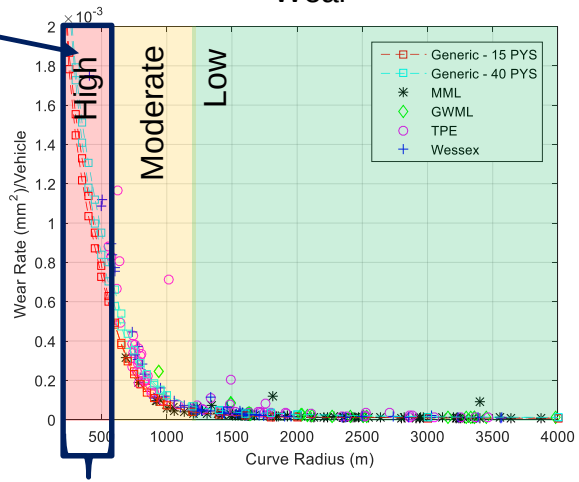
To reduce whole life costs, *premium rail steels* should be *considered* for use in critical curves where *RCF* or *wear* causes the premature replacement of the rail

Rolling Contact Fatigue



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

Wear



Used in in tight radius curves to increase resistance to wear

Network Rail

Microstructural characterisation

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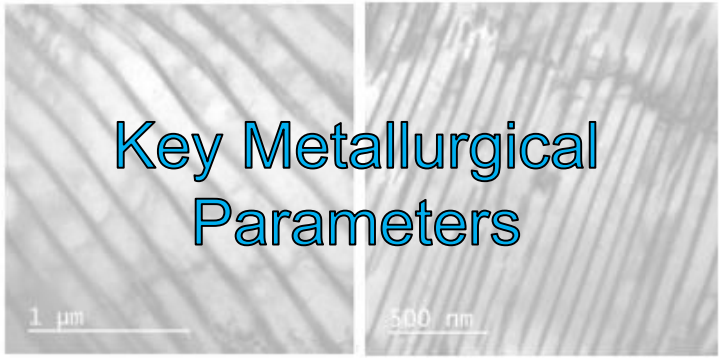
- *Metallurgical examination* used to identify contribution of composition and microstructure parameters on wear and RCF resistance

Hardness of hypereutectoid steels through accelerated cooling

Influence of fragmentation of pearlitic cementite lamellae

Finer interlamellar spacing considered to have a second order influence



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

Alloying with manganese considered beneficial for RCF resistance

Vanadium alloyed steels showed better resistance to plastic deformation

Further data required to investigate volume fraction of cementite

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Conclusions

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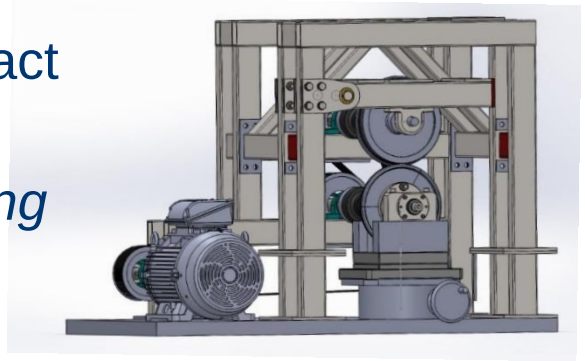
- Project has made some *key breakthroughs* in understanding the influence of *alloying elements* and *hardness* on *degradation of rail steel* microstructures
- *Damage susceptibility* of track sections has been assessed to formulate guidelines for deployment of rail steels type
- *Laboratory twin-disc 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

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