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The Spectrum Bogie

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Institute of Railway Research

Initial parameters can be determined in a number of ways:
- Calculation from fundamental principles
- Application of accepted vehicle design principles
- Engineering judgement/application of experience
- Derivation: for example the trailing arm bush parameters were determined by calculating their influence on primary yaw stiffness $K_Y$

$$K_Y = \frac{\Omega_T^2}{2} \cdot K_{TM}$$

$\Omega_T$ – Wheelset yaw angle
$K_{TM}$ – Trailing arm bush semi-spacing in given direction
$K_Y$ – Stiffness in given direction

A review of existing bogie designs led to a chosen base concept:
- Trailing arm primary suspension
- Coil sprung
- Viscous damped
- UIC secondary suspension
- Standard centre bowl and side-bearer arrangement
- Axle mounted disc brakes
  - Required to operate alongside passenger stock
  - Dictated external axle boxes

Review of existing bogie designs and identify an appropriate base concept

Determine initial values for suspension component parameters (lengths, stiffnesses, damping rates etc.)

Construct a mathematical vehicle model (in Vampire) to optimise those parameters for the required performance

An optimised running gear design was required

Axle mounted disc brakes
  - Required to operate alongside passenger stock
  - Dictated external axle boxes

A novel bogie concept was developed - featuring conventional/proven suspension components and technologies, but in a novel arrangement and application. Swing links were introduced to the UIC secondary suspension to improve lateral ride and stability.

Improved dynamic performance with reductions of between 8% and 16% in Variable Usage Charge compared to a conventional Y-series container vehicle (calculated with Network Rail’s Variable Track Access Charge Calculator)