NON-LINEAR QUASISTATIC CURVING THEORY FOR RAILWAY VEHICLES WITH COUPLED BOGIES AND TWO-POINT CONTACT INTERACTION BETWEEN GUIDING WHEEL AND RAILS

In this paper a quasi static curving theory for a railway vehicle is presented. This theory takes into consideration the special mode of interaction between worn guiding wheels and rails when the wheel touches the rail with two contact zones, one on the tread and the other on the flange – the latter with a high value of contact angle.

In this theory the contact conditions on the wheel treads are described with the prediction obtained from the BR Contact Patch Programme and calculated forces are related to these contact conditions with the use of the table of Kalker forces.

On the flange, full slip has been assumed, and the flange tangential force has been related to actual flange normal force and coefficient of friction between rail side and flange.

The theory describes normal tangential force distribution over two contact zones for guiding wheels and constant components of all forces acting on rails, other wheels, axle bearings, bogie frames and the body of the vehicle with two or three axle bogies and individual drive of each wheelset. This theory also describes the positions of each wheelset on the track and relative displacements between wheelsets and bogie frames, bogie frames and body, and lateral deflections of the rails under action of wheel forces. The relevant characteristics describing the connections between rigid bodies of the system such as wheelsets, bogie frames and body are represented by non-linear functions.

The theory also describes the influence of transverse connection between bogies on all forces and displacements for a vehicle negotiating the curve. The transversal connection characteristic has been described by non-linear function representing backlash, pre-tension of spring device of connection and its elastic deflection.

The computer output shows all above mentioned quantities on an easy readable table. An additional table presents wear rates for tread and flanges, rail heads and sides in the form of the energy dissipation caused by tangential forces during a unit distance travelled by the vehicle along the curve.

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Report Author(s): J Piotrowski
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