

Book Reviews

CONTACT MECHANICS AND FRICTION: PHYSICAL PRINCIPLES AND APPLICATIONS

V.L. Popov, 2010, 362 pp., 1st English Edition; Springer, Berlin, Heidelberg (hardback) ISBN: 978-3-642-10802-0

Everybody who deals with the problem of the contact mechanics between wheel and rail sooner or later has to deal with two books. One of these books is Johnson's book on contact mechanics (K. L. Johnson: *Contact Mechanics*, Cambridge University Press, 1985; 6. Edition 2001) and the other is Kalker's monograph (J. J. Kalker: *Three Dimensional Elastic Bodies in Rolling Contact*, Kluwer Academic Publishers, Dordrecht, 1990). Both books go beyond the rolling contact mechanics of wheel-on-rail contact. With Kalker, the problem revolves around numerical treatment of contact problems for elastic bodies. Everybody who wants to deal with contact mechanical problems for real wheel-rail systems, including wear, cannot ignore the work of Kalker. In Johnson's book a broad variety of contact mechanical problems are considered, not only in the field of theory of elasticity. Johnson always uses analytical, semi-analytical, or graphical solutions.

Now, as announced in the title, there is an additional book in this field at Springer publishing house, initially for the German-speaking world and now as an English edition. One naturally asks, if another book in this field is justified, given that two monographs on the subject already exist. The answer is definitely: Yes. The reason for this answer becomes clear from the title: Contact Mechanics and Friction go hand in hand. The subtitle makes it clear that the book is not limited to a purely mechanical problem, but rather it reaches back to physical fundamentals. The reviewer agrees with the author of this book in that (even with apparently "pure" technical problems such as the wheel-rail contact) it is impossible to avoid physical considerations, if one is required to tackle previously unsolved or unsatisfactorily solved aspects. The book by Popov allows new problems to be considered more easily than before.

Popov primarily writes not for academic colleagues, but for students and engineers in the field of contact mechanics. Valentin Popov believes that the essential aspects of contact mechanics and friction

are much simpler than they often appear to be. The author has succeeded in presenting very complicated situations in the simplest possible way. Thereby, he exposes himself to criticism from colleagues in the field of physics for oversimplifying matters. Obviously, he does not stop short of this criticism, for he first wants to help the beginner to overcome his psychological inhibitions.

Already by perusing the table of contents, a broader aspect becomes clear. Chapters 2 and 3 deal with a qualitative approach whereas Chapters 5 and 6 with a "rigorous" approach. Above all, it is essential to the author to gain fundamental insights with a qualitative approach; only then does the author draw near to a more stringent procedure for the exact solution. However, even there he still limits himself (for instance with Hertzian contact problems) to the simplest case (sphere on a half-space) for the generalized cases, once again he provides an approximation.

It is important to the author to convey basic insights into general problems: adhesive contact, roughness, frictionally induced oscillations, thermal effects, viscoelastic properties, wear, and influence of high frequency vibrations. Compared with the German edition one can find an additional chapter entitled "Earthquake and Friction". Of course, this chapter is not necessary for rolling contact problems; however it indicates how the author tackles completely new problems.

The focal point, above all regarding the wheel-rail contact, is composed of the rolling contact problem and Coulomb's law of friction. At this the Prandtl-Tomlinson model of dry friction is considered in detail.

In Chapter 19 of Popov's book, numerical simulation methods for contact mechanics and friction are covered. Of main interest is a procedure in which a three-dimensional contact problem is consistently represented as a one-dimensional problem. A certain proximity to Kalker's simplified theory is unmistakable. Popov, however, goes further when he applies his simulation method, which he calls *reduction method*, to the contact of rough surfaces. Different from Kalker (FASTSIM), the transition to arbitrary contact surfaces is (still) not possible.

The reader of this book should not expect a universal remedy. The fact that understanding is linked to some amount of effort will become very clear, at least,

when one attempts to tackle the numerous exercises. However, one who puts in the effort will be rewarded with a fundamental understanding of contact mechanics and friction.

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THE V/S SIC GUIDE TO BRITISH GAUGING PRACTICE

D M Johnson, Rail Safety and Standards Board (RSSB), 2010, RSSB Research Contract T926, London

This guide was written to introduce the subject of British gauging practices, covering a wide scope from simple vehicle gauges and gauging methods to the latest computer based software methods currently employed for the gauging process in Britain.

The guide begins with a brief introduction to the background history of gauging in Britain which includes a useful glossary of terms. It follows with a chapter on vehicle gauges offering insightful information on an area which can be quite confusing for those unfamiliar with the techniques used. A good example is the description of the peculiarities of network gauging in Britain especially for freight vehicles. The author explains for example that although a W8 freight gauge is widely known to be able to accommodate 8' 6" (2.59 m) high containers, this is only the case when the container is loaded onto suitable wagons with the correct deck height. It also highlights that the British freight gauges are not all nested within one another. Passenger vehicle, locomotive and track maintenance vehicle gauges are also covered including the effects of loading and tilting trains.

Further sections cover gauging methods such as comparative gauging, absolute gauging and hybrid gauging. Comparative gauging is a process of demonstrating that new rolling stock can operate on a route by comparing its dynamic swept envelope with an existing comparator vehicle already approved to run on that route. In absolute gauging, the actual space required to run a vehicle along a route is compared with the actual size of structures and adjacent tracks on the route. The guide also explains hybrid gauging which is a combination of gauging techniques used to clear a vehicle for a route where comparative gauging and absolute gauging techniques are applied to different parts of the vehicle. How structure clearances, track fixity, tolerances and electrification influences gauging are covered in the guide. There is also a brief

mention of the International Union of Railways (UIC) method of gauging which is adopted in Europe.

The chapter on platform gauging explains the relationship between vehicles and platforms highlighting the problem of achieving a balance between passenger accessibility and sufficient clearances for passing trains. A section on heritage rolling stock and steam locomotives describe the possible conflicts that may arise in running these vehicles on today's network due to the possibility that modifications have been carried out to the track alignment. The suitability of European style double decked trains is also briefly debated by the author. This is followed by a chapter on the surveying techniques employed in gauging which covers methods from the rudimentary pole and tape to laser profiling.

A flowchart attached in the appendix of the guide manages to clearly illustrate the route to gauging acceptance in an easy to understand manner. However it would also be helpful to include a diagram to show the various important points on a vehicle body such as the cant-rail and solebar. There is a recommended reading list and useful contacts for readers needing further information.

In conclusion, this is a comprehensive document covering all aspects related to gauging in Britain. Although some areas of the guide only skim the surface of a topic, it should be sufficient to kick-start the process of gaining a greater understanding of gauging practices in Britain to those new to the subject. Those wanting to run trains in Britain or involved in gauging processes may also find this guide useful to assist them in achieving their objectives.

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WHEEL-RAIL BEST PRACTICE HANDBOOK

F Schmid (Ed.), 2010, University of Birmingham Press, Birmingham, ISBN: 978-0-952-9997-3-7

The 'Wheel-Rail Best Practice Handbook' is published by the University of Birmingham and was commissioned by the UK rail industry Vehicle/Track System Interface Committee (V/T SIC). It is the latest collection of theoretical and practical knowledge on issues relating to the wheel-rail interface and in the broader sense, railway operations. Wheel and rail maintenance and replacement are two major cost drivers of the railway industry. From a physical

Springer-Verlag Berlin Heidelberg, 2010. 367 p. â€” ISBN:978-3-642-10802-0, e-ISBN 978-3-642-10803-7. This application-oriented book introduces the associations between contact mechanics and friction and with it offers a deeper understanding of tribology. It deals with the associated phenomena of contact, adhesion, capillary forces, friction, lubrication, and wear from one consistent viewpoint. The author goes into (1) methods of rough estimation of tribological quantities, (2) methods for analytical calculations which attempt to minimize the necessary complexity, (3) the crossover into numerica