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**Henryk Bałuch: Climate Change and Energy Consumption – Examples Associated with Railway Construction**

The practice of designing and constructing new railway lines should take into consideration certain global phenomena, whose significance will increase over time. One such phenomenon is the ongoing climate change. This is accompanied by a simultaneous depletion of nonrenewable energy sources. The occurring changes may trigger cause-and-effect sequences, which means that an effect may become a cause of another change or further changes. The article offers some short examples of such sequences – both those originating from nature and those that can be initiated while considering the railway infrastructure that is yet to come into being.

Keywords: railway construction, climate and energy consumption, cause-and-effect sequences

**Marek Bartczak: Switch Point Control Circuits with Small-size Safety Relays**

Relay-based railway signalling systems are constructed with safety relays, which are produced by the main signalling manufacturers. Such safety relays are hard to find on the market. Therefore signalling contractors frequently use small-sized, easily-available relays of the SF4 and H-464 type, which conform with the UIC736 normative requirements. The paper presents safety relays of the H-464 type as well as three-phase switch point control circuits, which are based on such relays cooperating with switch point transducers and utilized in centralised mechanical signalling systems with electrical switch-over of the switch points.

Keywords: railway signalling, switch point control, safety relays

**Danuta Bryja, Adam Hylński (Popiołek): Upgrading the railway infrastructure technical parameters using the example of the Control-Command and Signalling subsystem with the EC verification certificate**

Droppers connecting the contact wire and messenger wire of the railway catenary are characterized by zero or negligible compressive stiffness, hence they become slack under compression that is similar to bars' buckling. The paper presents a numerical analysis of the influence of droppers slackening phenomenon on the dynamic interaction between the pantograph and catenary. The analysis is based on a simulation method presented by the authors in previous papers, in which the catenary is modelled as a complex cable system. In this paper, the simulation method is modified by introducing the residual compressive stiffness of droppers that is assumed as a given percent of tensile stiffness. Modification leads to geometrically non-linear equations of motion of the pantograph-catenary system. Two different algorithms for solving the problem of non-linearity are proposed, in both of them the Newmark numerical integration method is applied. Results of dynamic response simulations performed for different values of residual compressive stiffness of droppers are presented and compared. It is shown that the contact wire does not cooperate with the messenger wire in a large area around the pantograph when the compressive stiffness of droppers is assumed zero. As a result, the pantograph moving at high speed induces severe vibrations of the catenary. It is also shown that droppers should be designed to have the residual compressive stiffness equal to at least one percent of their tensile stiffness. This is sufficient to ensure an appropriate cooperation between messenger wire and contact wire, which is demonstrated by simulation results fulfilling requirements given in the standard PN-EN 50318: 2002.

Keywords: railway catenary, pantographs, droppers' slackening, geometrical non-linearity, vibration simulation, validation of simulation method

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*Andrzej Brzeźny, Piotr Potępa, Andrzej Sowa:* **Correlation Between the Main Diagnostic Features of Rail Vehicles' Wheel Profiles in the Operational Period**

The paper is dedicated to correlations between the main diagnostic features utilised for assessing the wear of wheel tyre running treads and the wear of wheel flanges. The paper focuses on analysis of the correlations between these features in the period between the mounting of new wheel tyres or new monoblock wheels in a given wheelset up to their replacement. The wheels of Electric Multiple Units and shunting locomotives were the objects of the research. The measurement data obtained from a domestic railway undertaking contain, however, many errors. It was noted that in some cases the measured values were put in the wrong places on the measurement cards. It is also possible that in some cases the wheel surfaces were not prepared properly for measurements. For those reasons, only some data, for which there were no doubts regarding credibility, were chosen. Those data were appropriate for determining the trend line equations, which depict an overview of how the values of the diagnostic features are correlated with each other. The obtained functions of the characteristics of the changes in the diagnostic features as well as calculated Pearson correlation coefficients show that there is a significant correlation between those features. This is not dependent on the significantly different operational conditions of the groups of tested rail vehicles. Conclusions on the existence of significant correlations between the tested features can be used for the creation of innovative solutions dedicated for wheel diagnostics of rail vehicles. This especially applies to the design of analytical functions, which could be used for real time verification of the correctness of the measurement results.

Keywords: operational tests, rail vehicles, diagnostic features, wheel profiles, Pearson's correlation coefficient

*Szymon Finke , Mateusz Motyl:* **Technological Barriers to Interoperability in Railway Transport Between Europe and China**

The growth in freight-traffic between Europe and China is driving the quest for new transport routes between these regions. One of the options is to use railway routes. The concept of using railway connections is referred to as the New Silk Route. A number of analyses of freight traffic point to a huge demand for this type of transport since sea freight is marked by seasonality, long travel times and the growing problem of congested ports, both in China and Europe.

Currently, there are several railway connections between China and Europe. These connections are hindered by intermodal transport and transshipment, which extend freight travel time, generate extra costs and result in the low capacity of these connections. In order to increase capacity, new connections should be developed using the interoperability of all the railway routes between Europe and China. Many barriers, however, impede this idea. Many of those barriers are technological in nature.

This paper looks into technological barriers that constrain interoperability in railway transport between Europe and China. The first section sheds some light on the idea of interoperability, as well as railway connections between Europe and China. The second section points to the technological barriers in this kind of transport. The next section presents some possible solutions for removing the barriers. The final section provides a summary.

Keywords: transport Europe – China, Silk Road, barriers to rail transport, interoperability

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*Maciej Grzywna, Tymoteusz Rasiński: **Passive Safety Mechanisms in Freight Wagons***

Safety is one of the most important aspects of the railway sector. The issue is of particular significance in the transportation of hazardous goods that pose a threat to human health and life and have a damaging effect on the natural environment. Modern structures of freight wagons meet the requirements specified mainly in the International Carriage of Dangerous Goods by Rail (RID), enabling safe transportation of these goods by rail. Equipping them in appropriate passive safety mechanisms makes it possible to limit the negative effects of any potential adverse events. These mechanisms feature sub-assemblies that make it possible to absorb impact energy, eliminate the wheel climbing phenomenon, detect instances of derailment, and reduce the damage caused to wagon filling valves.

Keywords: passive safety, freight wagons, dangerous materials, railway sector

*Wojciech Sawczuk, Mateusz Jüngst: **Numerical Analysis and Testing of a New Segmented Brake Disc Fixed to the Wheel of a Wheelset***

In electric multiple units due to the existence of the wheelsets, the brake discs are mounted on wheels of wheelsets. Although the braking of the vehicle is carried out mainly using an electrodynamic brake, depending on the type of braking implemented, a friction brake is additionally used in some braking phases. In the operation of driving wheelsets, the wear of the friction surface of the disc to the limit dimension occurs faster than the wear of the wheel rim. As a consequence, in the case of replacing full discs, it is necessary to squeeze the wheels from the axles of the wheelset, assemble the discs and press the wheels on the axle again. Squeezing and re-pressing the wheel due to the scratching of the axle surface is not possible to be repeated. For this reason, brake disc manufacturers offer split disks that enable their assembly without extrusion of the wheel from the axis of the wheelset. Thus, there is no need to roll the wheelset out of the trolley frame.

The article presents the construction of a new segment brake disk after testing on an inertia brake station for testing railway disc and block brakes based on Polish standards [2, 3]. With regard to the disc's construction itself, a new technology for its implementation has been proposed. Most brake discs are produced by casting and finishing machining. In the case of the proposed brake disc, the prototype of the disc was made by welding the venting elements with the disc's friction plate. The proposed brake disc was created during the implementation of the LIDER V project financed from the National Center for Research and Development in Warsaw.

Keywords: segmented brake disc, welding of the brake disc, bench tests