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Editor's

Jarosław Moczarski
Scientific Secretary of the Railway Research Institute

The scientific and research activity of the Railway Research Institute covers issues connected with transport by rail. The Institute's staff carry out research work in the area of railway permanent ways, passenger and freight services, command-control and signalling, rolling stock and electric traction supply. There are also conducted projects on logistics, natural environment protection, transport of persons with disabilities. There are performed tests of materials and structures used in rail transport. Special attention is drawn to safety problems in rail transport. Several research projects are dedicated to modelling of rail transport systems and processes.

Experienced staff, modern technical equipment as well as unique state-of-the-art measurement instruments allow carrying out projects aiming at creating new innovative solutions in rail transport.

The scientific and research activity is carried out within numerous research projects conducted together with partners from universities, research institutes, railway companies and private businesses. Significant projects are funded by the European Union, Ministry of Science and Higher Education, National Research and Development Centre and Polish Railway Lines PKP PLK S.A. Complex research tasks are also performed within commercial activities aiming at preparing specialist expert opinions.

The goal of the Institute's internal projects is to solve unique research problems (also as doctoral dissertations), develop new research methods and upgrade or construct new test stands fitted with modern measurement equipment.

The results of performed projects are published in Polish and international indexed scientific journals and in quarterlies issued by the Institute Railway Reports (Problemy Kolejnictwa and Prace IK). The Institute's Publishing House, which specializes in publications in the transport area, issues monographs prepared by the Institute's staff. The effects of the projects are also presented at the Institute's open scientific seminars as well as national and international conferences organized by the Institute.

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Signing Letter of Intent between POLTRIN and PKP S.A.

On 2 March 2020, a meeting attended by representatives of Polish State Railways PKP S.A. and institutes grouped in the POLTRIN network, i.e. Road and Bridge Research Institute (IBDiM), Motor Transport Institute (ITS) and Railway Research Institute (IK) was held at the IBDiM premises. Consequently, the participants signed a Letter of Intent intended to launch a cooperation and exchange of knowledge within the scope of implemented and planned R&D and innovative projects covering road and rail transport between:

- Polish State Railways PKP S.A.,
- Road and Bridge Research Institute,
- Motor Transport Institute,
- Railway Research Institute.


Photo: IBDiM

Meeting with Carlo Borghini at PKP S.A.

A meeting with Carlo Borghini, the Director General of Shift2Rail Joint Undertaking (S2R JU) was held at the seat of PKP S.A. on 11 March. The aim of the meeting was to discuss the role of Poland as a key S2R JU partner integrating Eastern Europe with the West of Europe in order to develop a unified railway system.

At the invitation of Mirosław Antonowicz, PKP S.A. Board Member, the Railway Research Institute was represented by dr Eliza Wawrzyn. The other participants included representatives of Road and Bridge Research Institute (IBDiM), Motor Transport Institute (ITS). These institutes make up POLTRIN network, which is due to be PKP S.A. cooperation partner. Moreover, the other participants represented the Centre for EU Transport Projects, Central Transportation Hub, National Contact Point for Research Programmes of the European Union, Łukasiewicz Centre and PKP Informatyka.

Due to the coronavirus threat, the meeting was organized as a video conference in English.

Carlo Borghini presented general assumptions and structure of the current Shift2Rail Joint Undertaking as well as the plan and estimated agenda of its continuation. Shift2Rail JU in the new financial perspective will be replaced by European Institutional Partnership named Transforming Europe's Rail System, commonly called Shift2Rail2.

Shift2Rail2 is assumed to be established in the second half of 2021 and its budget might be even twice as big as present Shift2Rail JU. Its goal is to increase the innovativeness of the rail system in connection with other means of transport. The key areas of improvement include, among others: Automatic Train Operation (ATO), Mobility-as-a-Service (MaaS), Logistics on Demand (LoD), energy consumption optimation, time of service to the second, costeffective railway, cybersecurity, intelligent trains, future railway stations, sustainable urban mobility, fast and reliable implementation of innovation.

The meeting also covered the issue of the possibility to increase Polish businesses' and enterprises' engagement in R&D projects implementation for railway in the present (Horizon 2020) and future (Horizon Europe) financial perspective. It was stressed that together we have an opportunity to create an efficient R&D environment as well as schedule further undertakings which should be taken in order to strengthen the role of Poland as a strong partner of Shift2Rail and Shift2Rail2 in the R&D area in Central Europe.

During the video conference with Carlo Borghini the participants presented the achievements and potential of their institutions. Dr Wawrzyn provided information about the IK areas of activity, also within the Programme under discussion. It was a big support and a clear signal that the Polish side is willing to increase our country's participation in Shift2Rail and also showed C. Borghini that we will strive together to significantly improve Polish partners' activities and involvement in projects carried out within Horizon Europe in the future perspective.

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Wood Materials of Track Superstructure

Marcin Garbacz
Engineering-Technical Specialist, Railway Research Institute

Wood materials of track superstructure are made from pine, oak and beech wood. Due to the place of use, the wood elements of the track superstructure are applied as sleepers, switch bearers and bridge girders. Wood is a natural composite material, which has good properties, e.g. as regards flexibility (effective vibration damping), strength and resistance to operating conditions, it does not show electrical conductivity (necessary in relation to railway electrical installations) and is also much cheaper than pre-stressed concrete superstructure elements.

In order to provide adequate resistance and durability of wood used as a railway superstructure material, it is subjected to saturation with creosote oil (in Poland, oil type B and C) using the high-pressure Rüping method, known as the vacuum-pressure treatment method. Thanks to this impregnation method, we are able to protect pine wood material for about 20 years and oak and beech wood for 25 years, whereas for unimpregnated wood it would be only a few years depending on the external conditions. Creosote oil, obtained from oil fractions derived from the distillation of coking tar has a number of advantages, among others good anti-rot and bactericidal properties and is not removed from wood material under the influence of water or ground moisture.

The basic standard specifying the requirements for wood materials of the track superstructure is the EN 13145+A1:2011 standard harmonized with the Commission Regulation (EU) No. 1299/2014 of 18 November 2014 on the technical specifications for interoperability (TSI) relating to the 'infrastructure' subsystem of the rail system in the European Union - Appendix C2 Technical characteristics of track design and switches and crossings design. This European Standard specifies wood species, requirements for quality, origin, production conditions, shapes, dimensions and tolerances, as well as durability and maintenance of wooden sleepers and switch bearers used in the construction of railway tracks. The standard does not include requirements for bridge girders as well as there are no requirements regarding the amount of oil absorbed by wood in the treatment process. Therefore, in order to supplement this standard, Polish standards are used, which are mostly withdrawn. One of these standards is PN-D-95014:1997, which specifies the requirements for the amount of oil absorbed by wood, however, it does not specify what kind of oil should be used. There is no one standard in Poland specifying the requirements for wood, its impregnation process and the amount of creosote oil absorbed by wood. A different situation occurs in other countries, such as Germany, where DIN 68811 complements EN 13145+A1:2011 and applies only when wooden railway sleepers are treated with creosote.

For many years, the Railway Research Institute has been carrying out research in the field of checking the correctness of track superstructure wood impregnation by sleeper treatment plants located throughout Poland (Czeremcha, Koźmin Wielkopolski, Lipa, Pludry) and later assessing the compliance and certification of products supplied by sleeper treatment plants. The Institute controls in detail the following:

– determination of the kind, type, variety, quality (defects), humidity, dimensions and protection against cracking of wood material according to EN 13145+A1:2011, PN-D-95006:1973, PN-D-95014:1997, PN-D-95013:1967 and related documents;
– determination of over-saturation (penetration) and absorption (retention) of impregnation oil absorbed by wood according to EN 13145+A1:2011, PN-D-95014:1997;
– checking the physical and chemical properties of the impregnation oil applied according to EN 13991:2003.

Fig. 1. Material of wooden track superstructure after impregnation in one of the sleeper treatment plants

The Railway Research Institute has also been conducting research and development work for many external entities for many years, where one of the most important task is the development of technical conditions for the performance and acceptance of sleepers, switch bearers and wooden bridge girders for PKP PLK. These requirements contain comprehensive requirements for the proceedings in the process of carrying out tenders for wooden track superstructure elements. Another example of the important work performed by the Institute is a comparative analysis of the chemical properties of creosote B and C oils, taking into account their impact on health and the environment.

Basing on many years of experience and data from numerous sleeper treatment plant inspections throughout the country, the Institute regularly publishes articles on issues related to the wood superstructure and the impregnation process in rail industry journals, including Railway Reports (Problemy Kolejnictwa). For many years the Institute has also been issuing numerous expert opinions in the field of assessing the quality and durability of wooden track superstructure built already in the track showing signs of early decomposition or defects, e.g. cracks.

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Railway Research Institute's Involvement in R&D Projects in 2017–2020

Renata Barcikowska
Head of Project Coordination and International Cooperation Unit, Railway Research Institute Press Officer

The Railway Research Institute (IK) plays a leading role in carrying out research and development and certification work in the area of railways and urban rail transport. The IK priority tasks include: substantive support of entities, decision-makers, transport organizers, operators, investment projects, the process of Community law, improvement of the staff competence in the broadly understood transport sector and improving transport safety.

The Railway Research Institute participates in the Shift2Rail programme, which is part of the European Union's Horizon 2020 Framework Programme and is the first European railway initiative. Its goal is to search for appropriate research, innovation and market solutions in order to integrate new and existing advanced technologies and create innovative products that can be implemented in rail transport. As part of Shift2Rail, IK participates in the In2Stempo project entitled Innovative Solutions in Future Stations, Energy Metering and Power Supply. The project is in line with the main assumptions of the Shift2Rail project and is aimed at reducing product life cycle costs, improving reliability and punctuality, while increasing capacity, as well as improving rail interoperability and increasing passenger satisfaction. As part of the Ministry of Science and Higher Education (MNiSW) programmes, the Institute received support for the participation in the framework programme (co-financing of IK own contribution) and funds for co-financing of involved scientists, the so-called Bonus on the Horizon, for the implementation of the international project of scientific units in the Horizon 2020 programme.

Table 1. IK participation in Shift2Rail initiative

Programme	Title of the project / Duration	Kind of co-financing
Horizon 2020	*In2Stempo*: Innovative Solutions in Future Stations, Energy Metering and Power Supply 2017-09-01 : 2022-08-31	Co-financed by the EU
	In2Stempo: Innovative Solutions in Future Stations, Energy Metering and Power Supply 2018-03-16 : 2020-08-31	Request for contribution to participation in framework programme for research and innovation, *Bonus on the Horizon*
	In2Stempo: Request for contribution to co-finance an international project, 2018-06-19 : 2020-08-31	MNISW, National funds to co-finance *In2Stempo* project

In 2017–2020, the Railway Research Institute showed the greatest activity in obtaining funds for research and development in projects from the National Centre for Research and Development (NCBR). Currently, as part of competitions for application projects (Sub-measure 4.1.4), IK is involved in two projects. The project entitled ***A simulation training system for shunting locomotive drivers and sidings and marshalling yards employees involved in shunting processes to increase their efficiency and safety*** is implemented jointly with Sim Factor Sp. z o.o. and its purpose is to conduct R&D work, as a result of which a simulation training system for the railway sector will be developed.

The second project called ***Intelligent video monitoring of containers*** is carried out in a consortium with the Institute of Science and Technology STIPENDIUM, the company MobileMS Sp. z o.o. and KODEGENIX Sp. z o.o. Its idea is to develop a demonstration installation and validate technologies leading to an innovative product called IMW in the form of an intelligent monitoring system for railway wagons.

Together with the Ministry of Infrastructure, the Ministry of Development and Kozminski University, IK is involved in the project entitled ***An innovative and standardized development model for the purchase of passenger rolling stock - Innorail***. The main objectives of the undertaking implemented within the strategic scientific research and development programme named Social and economic development of Poland in the conditions of globalizing markets - GOSPOSTRATEG are the following:

- providing a tool to facilitate the implementation of development policy, including fostering socio-economic, regional and spatial cohesion of the country,
- increasing the competitiveness of the economy,
- increasing the accessibility of the labour market and public services for citizens by supporting the efficient operation of rail transport adapted to the needs of various users.

In 2017, the National Centre for Research and Development announced a competition in the program called BRIK - Research and Development in the Railway Infrastructure. It is a research and development support programme in the area of railway infrastructure financed by the NCBR and PKP Polish Railway Lines (PKP Polskie Linie Kolejowe S.A.). The competition was announced in five thematic groups:

1. digitalization and processing of railway traffic parameters,
2. decrease of rail transport's negative impact on the environment,
3. increasing the accessibility and durability of facilities connected with customer service,
4. increasing the railway infrastructure resilience to climate factors and interference by third parties,
5. improving the process of railway infrastructure maintenance and modernization.

The main goal of the Joint Undertaking is to increase the innovativeness and competitiveness of rail transport by 2026. The implementation of the program is to contribute to the increase of R&D activity in the area of railway infrastructure, growth in the number of innovative solutions in this area, improvement of the railway infrastructure operation and management efficiency and reduction of rail transport's negative impact on the environment. Thirty applications were submitted. Ten innovative projects were selected for funding, including five in which the Railway Research Institute is involved as a leader or a consortium member (Table 2).

Table 2. Railway Research Institute's involvement in BRIK projects

Project	Contractors	Date of the project start and completion	Total NCBR co -funding value
Development and implementation of OCL anti-theft system elements in rail transport	IK, Neel Sp. z.o.o.	2018-06-01 2021-09-30	**444 075 PLN**
Development of innovative system of lighting infrastructure management on the network managed by PLK S.A.	IK, Siled Sp. z o.o., Zakład Automatyki Urządzeń Pomiarowych AREX Sp. z o.o., ABZ Consulting Sp. z o.o.	2018-07-01 2020-04-30	**416 675 PLN**
Standardization of selected computer interfaces of railway command-control and signalling devices and systems (srk)	IK, Rail-Mil Computers Sp.z o.o. Sp.k.	2018-06-01 2021-09-30	**1 872 481 PLN**
Optimization of the ultrasonic transducer system for detecting internal defects of rails in accordance with the catalogue of defects in force at PKP PLK S.A.	IK, Institute of Fundamental Technological Research Polish Academy of Sciences (IPPT PAN), ZBM ULTRA Sp. z o.o.	2018-10-01 2021-09-30	**366 938 PLN**
Innovative solutions regarding people and building protection against rail traffic vibrations (IK as a consortium member)	IK, Warsaw University of Technology, Budimex, Tines S.A., Institute of Environmental Protection	2018-06-01 2021-05-31	**708 256 PLN**

Source: the author's own elaboration basing on IK data

The cooperation of specialists from the Railway Research Institute and the companies: Siled Sp. z o.o., Zakład Automatyki i Urządzeń Pomiarowych AREX Sp. z o.o. and ABZ Consulting Sp. z o.o. will consist in developing a management, control and monitoring system for railway area lighting. These works will allow the lighting to be adjusted to the actual train movement at the stations and the presence of travellers on the platforms.

Actions on innovative solutions that limit the negative impact of rail transport on people and the environment will be undertaken by: the Warsaw University of Technology, Railway Research Institute, Institute of Environmental Protection in consortium with Budimex and Tines S.A.

An interesting project implemented by the Railway Research Institute in cooperation with Neel will be the construction of an anti-theft catenary system. The goal of the project is to monitor the condition of the overhead contact line, and in the event of a violation of the continuity of the elements (breaking, cutting, theft of the OCL or suspension line) to notify the services responsible for protecting the railway infrastructure. New solutions designed will certainly help to guarantee high reliability for rail transport. The use of modern information systems and technologies will improve security and safety.

As a result of the project implementation ***Standardization of selected computer interfaces of railway command-control and signalling devices and systems (srk)***, new standard interfaces of railway command-control and signalling devices and systems will be implemented. They are intended for use in the railway network managed by PKP PLK S.A. (as well as other infrastructure managers), along with documentation containing a description of the standards, guidelines for application and designing of these interfaces.

The aim of the project entitled ***Optimization of the ultrasonic transducer system for detecting internal defects of rails, in accordance with the catalogue of defects in force at PKP PLK S.A.***, is the development of an optimal configuration of ultrasonic transducers for a flaw detector wagon and single-rail manual measuring devices. It will contribute to detecting more defects, which will directly translate into increased traffic safety. The project will enable the provision of rail measurement services for PKP PLK S.A. and foreign railway infrastructure managers.

The Institute's scientific and research activity directly affects the development of innovation, it also has an impact on shaping the innovation policy. Every year, the number of projects, both international and national, in which IK is involved, increases.

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National Technical Assessment vs. Placing on the Market of a Construction Product

Renata Basińska
Engineering-Technical Specialist, Railway Research Institute

National technical assessments (KOT) were placed on the domestic market on 1 January 2017 and replaced already issued technical approvals.

The Journal of Laws (JoL) of the Republic of Poland (Dziennik Ustaw) of 13 August 2015, item 1165 includes the act of law of 25 June 2015 on amending the act of construction products, the act on Construction Law and the act amending the act of law on compliance assessment system establishing, among others, new conditions on placing construction products on the domestic market as well as two regulations:

- Regulation of the Minister of Infrastructure and Construction of November 17, 2016 on how to declare the performance of construction products and how to mark them with a construction mark (JoL of 2016, item 1966, with further amendments),
- Regulation of the Minister of Infrastructure and Construction of November 17, 2016 on national technical assessments (JoL of 2016, item 1968).

In compliance with the afore mentioned regulations, technical approvals are no longer issued, amended and their validity periods are not extended. Technical approvals that had been issued before the new regulations entered into force may be used as national technical assessments until their validity period expires. The national technical assessment is a document confirming the positive assessment of the performance of the essential characteristics of the construction product, which, in accordance with the intended application, has an impact on the fulfillment of the basic requirements by the construction works in which the product will be used. The basic requirements are listed in art. 5 paragraph 1, point 1 of the Act of 7 July 1994 - Construction Law (JoL of 2020, item 148, with further amendments).

The national technical assessment is issued for a period of five years for a construction product:

- not falling within the scope of the Polish Standard (PN) for the product,
- if for at least one essential characteristics of a construction product the assessment method provided for in the product PN is not appropriate,
- if the PN of the product does not provide for an assessment method in relation to at least one essential characteristics of the construction product.

The Railway Research Institute (IK) has been designated by the Minister of Infrastructure and Construction as a national technical assessment body for providing national technical assessments. The manufacturer or its authorized representative applying for issuing a national technical assessment for a construction product intended for use in rail superstructure in accordance with the scope set out in the Annex to the Decision of the Ministry of Investment and Development No. 1/KJOT/WB/ 2018 of 06.08.2018, may submit an application for a national technical assessment (KOT). The application for issuing a KOT must be accompanied by technical documentation which contains:

- a range of products their with technical description, drawings and a list of dimensions,
- characteristic information sheets of raw material and materials from which construction products are manufactured,
- reports from tests confirming the performance of construction products,
- the description of the factory production control and relevant information concerning the production process,
- proxy (if the manufacturer appointed its authorized representative).

The national technical assessment is a document referring to the preparation of the national declaration of performance and marking of a product with a construction mark B. A construction product may be placed on the market provided that it has been marked with a construction mark. Marking a product with a construction mark is eligible if the manufacturer has conducted a conformity assessment and issued the national declaration of performance on its sole responsibility.

Before issuing the declaration, the manufacturer is obliged to carry out the assessment and verification of constancy of performance based on the requirements of the conformity assessment system, which has been assigned to individual groups of construction products in Annex 1 to the Regulation on the method of declaring performance of construction products and how to mark them with a construction mark.

We currently have five assessment systems: 1+, 1, 2+, 3, 4. The 1+ and 1 assessment system imposes on the manufacturer the obligation, among others, to hold the certification of conformity of the construction product issued by an accredited certification body. The 2+ system requires, among others, a certification of factory production control issued by an accredited certification body, and in system 3 the producer is obliged, among others, to carry out tests in an accredited laboratory. In system 4, on the other hand, all conformity assessment tasks provided for in this system (i.e. initial type testing and factory production control) are performed by the manufacturer, without any third party involvement.

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Revitalization of the Silesian Trams Network

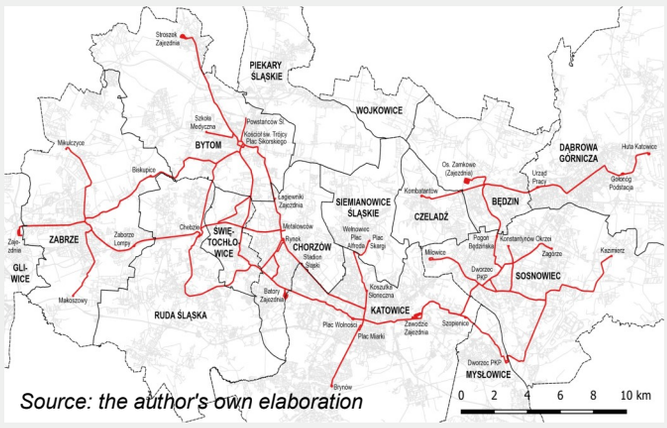
Andrzej Soczówka
Railway Track and Operation Department

The tram network connecting 13 cities of the Upper Silesian Metropolitan Area is one of the largest (340 km single track) and the most extraordinary tram network in the world. Built at the end of the 19th century, initially as a narrow gauge steam tram (785 mm), it was electrified after a few years, and in stages in the first half of the 20th century - rebuilt into 1435 mm track. Between the First and the Second World War, the Polish-German border divided this network in 7 places. Initially, the lines were built as single-track with passing loops, later some of them were rebuilt into a double-track.

Due to its historical origins and a big number of single-track sections, tram traffic is operated similarly to the railway rules. Trams have a radio dispatch communication system, individual vehicles in the working timetable are called trains. On single-track sections, manual signalling (so-called boxes) or relay signalling is used, and on sections without signalling, permanent intersection points are designated in timetables. The only used 1435 mm track reversing triangle to change direction is functioning in Poland (Sosnowiec Konstantynów). At the beginning of the 21st century, the only intersection in Poland in Sosnowiec Niwka of the electrified sand railway line with the tram, i.e. with two different voltages in the OCL (600 V tram and 3000 V rail), was brought to an end. In Bytom there is the shortest tram line in Europe (Line No. 38), operated by historical two-way Konstal N-type rolling stock from the 1950s, used not only in everyday travels of residents, but also visited by tourists from Poland and abroad.

The tram network developed until the mid-1980s. The last major investment was the construction of a fast tram line from the centre of Sosnowiec to Zagórze (the largest district) completed in 1982 with a temporary loop at the end of the settlement. The financial problems of trams began in the 1990s, when after a failed municipalization trams became a state-owned enterprise and later a state-owned company. They were handed over to local governments in 2008, when due to insufficient funds there was a significant decapitalization of infrastructure and rolling stock. Frequent interruptions in operations occurred due to derailment or rolling stock failure. The second problem was the decrease in transport services on lines to closed workplaces. Thirdly - the general decrease in the number of passengers as a result of reductions on the number of routes introduced by the transport organizer after 2000. Consequently, some lines were closed (Line No. 1 and No. 4 Gliwice - only the depot remained, No. 25 from Będzin to Wojkowice, No. 8 from Bytom to Piekary Śląskie, No. 12 from Chorzów to Siemianowice Śl. and No. 18 in Ruda Śląska).

The closures of the lines actually coincided with the beginning of the implementation of large infrastructure and rolling stock modernization projects co-financed from EU funds. As part of the programme implemented in 2012–2015 (together with Tychy trolleybuses) 63 km of single track was modernized, the section from Bytom to the Łagiewniki district was rebuilt (Line No. 7), 42 new multi-section low-floor cars were purchased (30 - Pesa produced vehicles and 12 manufactured by Modertrans) and 75 old Konstal 105N cars were modernized. The project implemented since 2016 assumes, among others, the completion of construction of Line No. 15 in Sosnowiec Zagórze, modernization of a significant part of the network (including reconstruction of the route from Chorzów to Ruda Chebzie into two-track) and purchase of 45 new cars. Some of the rolling stock and some sections of the network are being modernized with their own funds.



Source: the author's own elaboration

Fig. 1. The Silesian Trams Network

The projects implemented improve the efficiency and reliability of trams, the overall image, attractiveness and comfort for travellers, develop integration with other modes of transport, increase the share of the services in public transport, and reduce the negative impact of transport on the environment. The total value of EU projects is almost PLN 2 billion. Such large investments inspire optimism and create an opportunity that Silesian Trams will again become an attractive means of transport. On condition that the transport organizer provides trams with an attractive timetable and a tariff which is integrated with railways.

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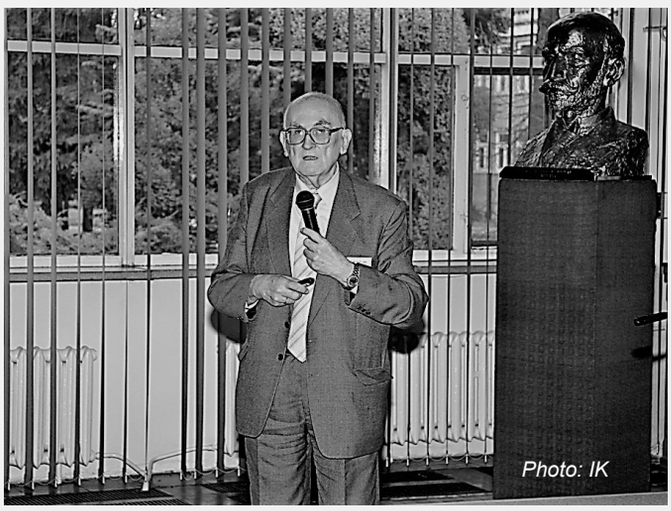
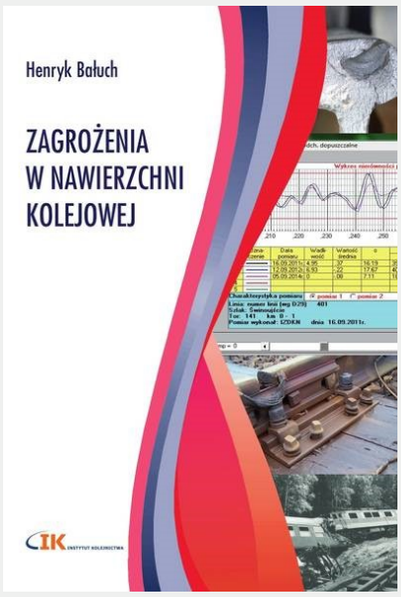
Professor Henryk Bałuch

Professor Henryk Bałuch, an outstanding specialist in the field of railways, passed away on 8 March 2020.



The Professor was always a special person for people connected with our Institute. He started working at the then Central Research and the Development Centre of Railway Technology (COBIRTK) in 1963, continued at Science and Technology Railway Centre (CNTK) and at the Railway Research Institute working for 57 years. In the COBIRTK he held the position of Deputy Director, then the Director, contributing to gaining significance and authority of our Institute. He left a legacy of monographs, which constitute the basis of knowledge to date in the field represented by the Professor, i.e. “Permanent Way Diagnostics”, “Optimization of Track Geometry Layout”, “Supporting Decision Making in Railways”.

In 2017, the Railway Institute’s publishing house published Professor's last book entitled "Threats to Permanent Way”.



Professor Henryk Bałuch's great scientific and organizational achievements were accompanied by such special personality traits, that were remembered by everyone who had the opportunity to meet him, as, above all, erudition and at the same time great modesty and outstanding personal culture. These qualities not only won him friends, but he was also a role model, the highest standard to which we should strive in our professional life.

He will be greatly missed.

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