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Original article

A unique type of industrial railway – the sand railways of southern Poland

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ABSTRACT

Since the mid-twentieth century, the Polish rail network has been experiencing a systematic decline of its lines and this includes railway lines serving only freight services. One of the most striking examples of freight transport is the sand railways in southern Poland. This world-unique system for transporting backfill sand used in hard coal mining was one of the most spectacular types of specialized rail transport. The general crisis of railways in Poland, the restructuring of the hard coal mining industry and changes in the technology for securing the underground parts of mines, have all resulted in a sharp decline in the role of sand railways as the carrier of backfill sand. The infrastructure system, as well as the companies involved in the exploitation of sand and its transport, have had to face the fundamental question about their future. This article indicates the essence of these challenges in the context of the role of sand railways in the freight rail system in general. The function of sand railways in the rail transport system has been recognized in relation to their specific unique features that have constituted important elements of their functional and spatial existence.

KEY WORDS: sand railway, mining railway, industrial region, typology, transport of freight, Silesia

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1. Introduction

The development of railways in Poland have gone through various stages – from the revolution in the nineteenth and early 20th century, after the modification of the system and its modernization in the second half of the 20th century, and a noticeable regression at the turn of the 20th/21st century (KOZIARSKI, 1989a, 1989b, 1993, 2010; HOWKINS, 1996; TAYLOR, 2007; KELLER, 2012; CIECHAŃSKI, 2013; SITARZ ET AL., 2019; TRAMMER, 2019). Since 2010, due to the absorption of funds from the EU and implementation of the policy limiting the emission of pollutants and energy consumption, and thus supporting electric rail transport, railways in Poland have entered the stage of a new possibilities (ZAŁUSKI, 2010; FALKOWSKI & PYTEL, 2014; JURKOWSKI & SMOLARSKI, 2017; TRANSPORT DEVELOPMENT STRATEGY, 2019). These phenomena are visible, among others in the slowing down of the process of closing of railway lines, the restoration of connections in passenger traffic, the revitalization of the railway infrastructure, as well as the incidental renovation of closed railway lines. Against the background of these positive changes in the last decade, one aspect of the transformation of railway networks has taken place in the opposite direction. This is the regression of the sand rail network in southern Poland. By sand rail, we refer to the system of railway lines created for the transport of sand, which has been used as a co-component of the liquid filling used in hard coal mines in this region of Poland (see more: SOIDA ET AL., 2007; CIECHAŃSKI, 2003a, 2013).

Sand railways were a unique type of industrial (mining) infrastructure. In many countries, industrial railways are an important element of the railway network (BENCE, 2012; BHATI ET AL., 2014; KREJČÍ ET AL., 2016; ENFLO ET AL., 2018; PIETRZAK ET AL.,

2021). Unlike other known special railway lines transporting mineral resources between mining and industrial plants or ports, this type of railway was unique. The uniqueness of sand railways is discussed later in the article.

The regression of sand railways, although determined by raw material resources, constituting the foundation for their creation and development, was severe for the system of standard-gauge railways in southern Poland. Their related challenges may constitute an important element of the spatial policy of municipalities in the region (see RESOLUTION NO. 618/2018 CITY COUNCIL OF SIEMIANOWICE ŚLĄSKIE, 2018; SUIKZP OF THE CITY OF SOSNOWIEC, 2018; SUIKZP OF THE CITY OF MYSŁOWICE, 2021). An example is the takeover of the sand line by City Council in Katowice in order to create a velostrada in the area of Giszowiec and Nikiszowiec (http: //rowerowekatowice.org /...; https: //www.transport-publiczny.pl). A similar idea of revitalization arose some time ago from the Municipal Office in Mysłowice in order to connect southern and northern Mysłowice. These types of linear objects are often used to create recreational infrastructures and their function is still used to move residents between different parts of the city (public, recreational or housing estates) (see DRAGAN, 2017).

The network of sand railways and the associated infrastructure has not been the subject of research from the perspective of heritage, so important for "traditional railways" (COULLS, 1999; HALL, 1999; BHATI ET AL., 2014; WHEELER, 2014; ROSA, 2018).

The regression of sand railways, or in fact their symbolic liquidation (backfilling sand is no longer a commodity transported on the remaining "thinned" sections of railroads), contributes in this article to a discussion on the typology of railways serving the transport of goods. The article focuses in particular on sand railways, and also refers to mining railways. In this context, the aim of the article is to indicate the place of the former sand railways in the systematized structure of freight railways within a functional and spatial context.

Although the subject of sand railways in railway transport systems had considerable scientific and popular scientific achievements after 1990, explanations regarding the in-depth functional and spatial typology were lacking. The article aims to fill this gap as a starting point for further discussion on this topic.

2. Literature review

The research on sand railways should be considered from several perspectives. Each of them brings an important element of cognition and explanation, These approaches can be formulated as follows:

a) sand railways as an element of mining and industrial railways in geographic and economic research. This research has significant achievements both in the context of explaining the essence of the sand rail system, their regional role, or location, in relation to the general development of the rail network, including railways specializing in freight transport (JERCZYŃSKI & KOZIARSKI, 1992; MALCZEWSKI, 2001; SOCZÓWKA, 2019; KELLER, 2021).

This type of research was developed in the 1990s and in the 21st century. Noteworthy are the in-depth works of KOZIARSKI (1990), RUSAK (2001, 2003), and CIECHAŃSKI (2003a, 2003b, 2004, 2013). In earlier works, sand railways, however, were noted in publications on railways, and constituted a certain margin of interest for the authors. Undoubtedly, it is interesting that the sand railways were not included in the transport chapter in an important publication on the geography of Polish transport (LIJEWSKI, 1986). The transport of sand is included there only for construction purposes and as part of the PKP railway network. However, it should be mentioned that their existence was noticed at all. In the earlier publication on the "Development of the Polish rail network" there is a mention of the creation of a "sand main line" supplying hard coal mines (LIJEWSKI, 1959),

b) technical and infrastructural conditions for the operation of sand railways, also within sand mines (SZCZYGIEŁ, 1971; SOIDA ET AL., 1996, 2007; OLENDER ET AL., 2004; GLAPA & KORZENIOWSKI, 2005),

c) regional and local monographs on the development of railways, including those which take into account the operation of sand railways (SOIDA ET AL., 1996, 2007; GÓRNIAK ET AL., 2019; GRANDA, 2021),

d) sand railways in terms of popular science. In this case, the point of reference is the type of publication, not the approach. It should be emphasized, however, that in the case of sand railways, popular science literature presents a high level. In this group of publications, in addition to books and folders, the specialized journals devoted to railways play an important role: Świat Kolei, Stalowe Szlaki, Rynek Kolejowy.

e) cartographic studies based on GIS methods. These include all kinds of maps, plans, diagrams, published both in paper (e.g. STANKIEWICZ, 2014) and digital formats (https://www.atlaskolejowy.net/). They also include contemporary and archival publications and studies;

f) an aspect of research related to the development of the railways themselves is the question of the functioning of backfill sand mines. Research in this area is very broad and covers mainly environmental and operational issues (SZCZYGIEŁ, 1971; KORZENIOWSKI, 2010; DULIAS, 2013; PEŁKA-GOŚCINIAK, 2014).

3. Sand railways – an outline of their development

As mentioned in the introduction, sand railways are a network of rail lines built to transport backfill sand. Backfilling sand was transported from opencast mines to nearby hard coal mines. This definition includes two sorts of sand railways:

– spatial–functional and spatial,
– legal and organizational.

The first approach, is a broader one, and it should be added here that the concept of sand railways is synonymous with the term: railways built to transport backfill sand to mines. In this approach, to which the article sand railways mainly refers, it covers also all infrastructural and socio-economic undertakings that were related to the transport of the sand.

From the legal and organizational point of view, the concept of sand railways should be understood as a network of standard railway lines that had a purpose similar to the one indicated above in the last approach. In legal and organizational terms, the sand railways started in 1905, when the first railway line of this type was opened from Przezchlebie village to the Glückauf shaft in the Królowa Luiza hard coal mine in the city of Zabrze (SOIDA ET AL., 2007). After World War II, sand railways were organized as part of company: Przedsiębiorstwo Materiałów Podsadzkowych – Przemysłu Węglowego (PMP–PW) (eng. Company of Filling Materials in Coal Industry). In the second half of the 20th century, and especially in the 1970s, the sand rail network was electrified (SOIDA ET AL., 2007). A turning point in the operation of the sand railways was in 1990, when the PMP–PW was dissolved, dividing it into several companies. Further legal, administrative and organizational changes took place in the 1990s and at the beginning of the 20th century. These were followed by the regression of the network and infrastructure of the sand railways as well as a systematic change in the structure of transport (Fig. 1B). However, it should be stated that the use and transport of sand for backfilling purposes took place earlier in the study region – in the second half of the 19th century. History of the sand railways in Poland can be divided into 4 stages:

– initial, mainly related to the operation of narrow–gauge sand railways and short sections of standard–gauge railways (until the beginning of the 20th century),
– line development, related to the construction of independent lines and sidings for standard–gauge railway lines (first half of the 20th century),
– network development and integration (second half of the 20th century),
– network disintegration and diversification of transport functions (2000–2010)[1],
– network disintegration and the disappearance of the primary transport functions (2020).

The stage of line development, as well as the development and integration of the network, corresponds with the legal and organizational period of the existence of sand railways in the study region.

In the period of over 100 years of development, the sand railway served several dozen large hard coal mines, as well as over 50 sand fields and sand pits. It functioned in most cities in the central and south-western part of today's Śląskie Voivodeship, as well as in individual towns and rural communes of the Małopolskie and Opolskie voivodeships. The sand railway was also present in all the cities in the core of the Katowice conurbation. The last point is important because it is one of the most populous urban regions in Europe. The total length of the rail network has varied over the decades. Changes in the length of the sand rail network belonging to PMP–PW are presented in Figure 1A.

The expansion and changes to the sand rail network were related to the operation of individual hard coal mines, but also to the availability of sand resources in individual mines. In the study region, sand from the Pleistocene fluvioglacial layers was mined, the thickness of which often exceeded 70 m (DULIAS & HIBSZER, 2004). From the 1930s, these opencasts were getting more and more distant from the coal mines, which was related to the exploitation of sand from the less urbanized outskirts of the Katowice conurbation. Mining of filling sand has become one of the characteristic elements of the functional structure of the region, and the excavations themselves have become an important challenge for environmental policy (DULIAS, 2004, 2010;

[1] Transport diversification began in the 1970s, which was related to the overloading of railway lines belonging to PKP (Polskie Koleje Państwowe – Polish State Railways).

KRZYSZTOFIK ET AL., 2020). The exploited open pits were developed as water reservoirs, dumps for post–mining waste or built–up areas. Some of them were planted with trees as a planned forest or natural succession of the vegetation took place. Some of the exploited open-pit mines, or their fragments, were used as zones for the expansion of the sand railway infrastructure. As mentioned, since the turn of the 20th/21st century, the railway network has been systematically reduced, and only those sections for which new transport functions have been found – other than sand for backfilling purposes – are active. Network decommissioning from the beginning of the 21st century was also accompanied by its de–electrification. Due to the discontinuation of the use of sand for filling purposes, the unloading bridges (at the sand transport destination), as well as decapitalization of other infrastructure – viaducts, stations, stops, signaling and other facilities created for the needs of sand railways, the decline of sand railways deepened. A diagram of the sand rail network in the 1980s is shown in Fig. 2.

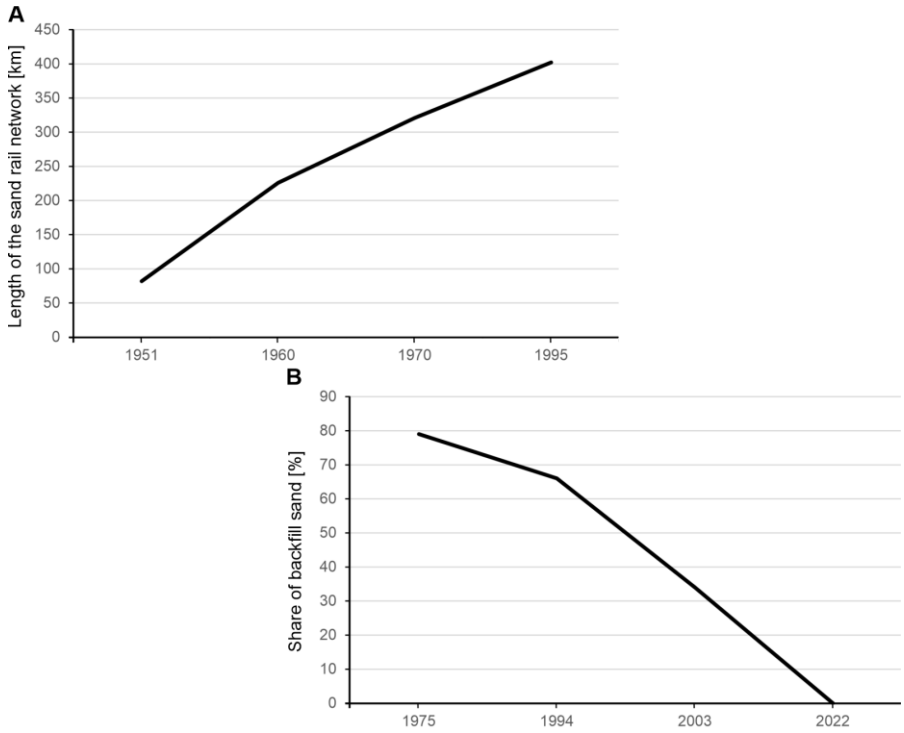


Fig. 1. The length of the PMP–PW sand rail network in southern Poland in 1951–1995 (A) and the share of backfilling sand in the PMP–PW transport structure, including companies established on the basis of this enterprise (B) (Source: Author's own elaboration based on Soida et al., 2007)

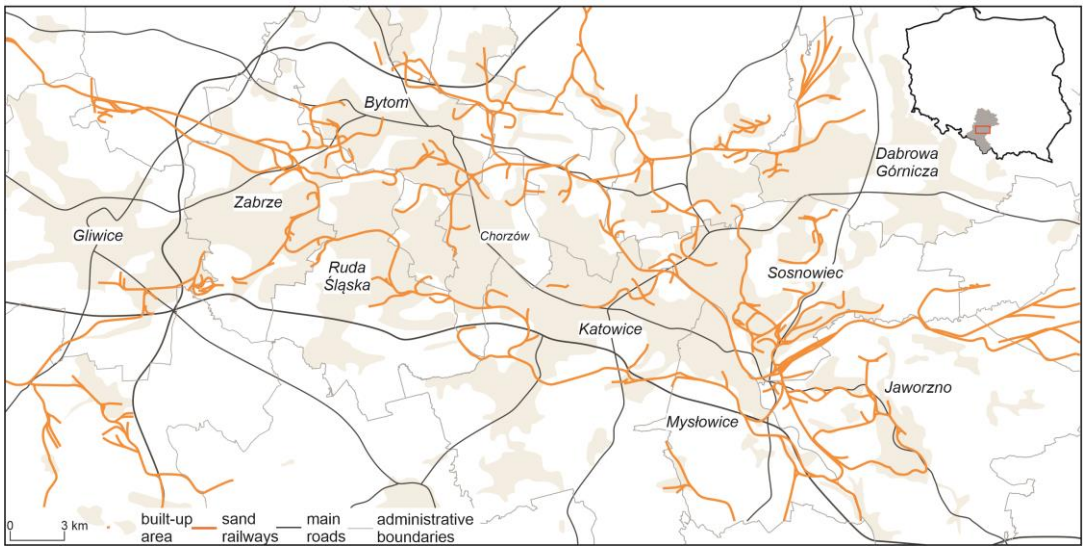


Fig. 2. Diagram of the sand rail network of the Katowice conurbation in the mid-1980s
Explanations: The map presents the sand rail network of the former PMP-PW and railway sidings in the areas of mines and power plants used to supply sand or to remove waste. (Source: Author's own elaboration based on Stankiewicz, Stiasny, 2014)

4. Specific features of the sand railways in southern Poland

The existence of sand railways, as well as any other type of railways focused on freight transport, should be seen in a broader perspective. DZIADEK (1991, p. 45) described this perspective as the complexity of the forms of the transport system as an attribute supplying the socio-economic system. The author distinguished three dependencies:

– quantitative, illustrating the relationship between the state of the capacity and the transportation needs,

– qualitative, conditioning the requirements of a certain transport weight in relation to the conditions of transport, and

– spatial, requiring spatial systems adapted to the needs of the surroundings, inputs to the transport system with the relationship between these inputs.

All of these attributes were met by the sand railway as a transport subsystem, and its regress can be accounted for by endogenous factors (depletion of sand deposits, liquidation of hard coal mines, and the later abandonment of liquid filling in coal mining) and exogenous factors (the political system transformation of 1989 and its multifaceted factors and consequences – economic and social). This problem is mentioned by DZIADEK (op. cit., 45), who wrote: "non-compliance with the requirements resulting from these dependencies negatively affects the functionality of the transport system and the areas it serves". It was these multifaceted inconsistencies that constituted the basis for the regression of sand railways as an definitional system and advanced restructuring in terms of such elements as: the total network of railway lines, the network of electrified lines, railway infrastructure, technical and repair facilities, employees, spatial location of the conducted activity or the volume of freight transport. The above-mentioned incompatibilities can be viewed from a broader perspective, externalized by the more general crisis of rail transport at the turn of the 20th/21st century, but it should also be seen in terms of the individual characteristics of sand railways and their specificity.

The sand railway, due to its functional specificity and geographical location, had several characteristics which, in a multifaceted juxtaposition, gave it originality and uniqueness in relation to other types of industrial railways. Most of these features were unique only to sand railways.

4.1. Parallel network

As mentioned above, in the south of Poland, sand railways created a specific network that operated independently of other types of industrial railways and the state-owned passenger–goods railways (PKP). It was not a unique feature, but a rare one (CIECHAŃSKI, 2018). However, taking into account the fact that the sand railways in southern Poland had the longest and relatively densest network of standard–value lines and sidings, they formed a multiple complex system. The other network systems diagnosed by CIECHAŃSKI (2018) were either complex (coal railways) or simple (KiZPPŻ Siarkopol or KiZPPPŻ Zębiec). The structure of sand railways was also more complex than all industrial narrow–gauge rail systems located outside the study region (LIJEWSKI, 1986; SOIDA ET AL., 1996). Only the network of industrial and mining railways (Górnośląskie Koleje Wąskotorowe – The Upper Silesian Narrow Gauge Railways) after World War II was more complex (SOIDA, 2020). Like sand railways, they had a complex network. In many sections, the sand railways contributed to specific systems of connections in geographical space. They had the character of adjacent tracks of the sand, and other types of railway lines, as well as point (junction) joints of various types of railways, mainly in the area of hard coal mines. These were normal and narrow–gauge PKP siding tracks, normal and narrow–gauge (underground) mining railways, and even in many plants – cableways. A sketch of such a typologically complex railway transport system in the area of coal mine KWK Wujek in Katowice was presented by SOIDA ET AL. (2007). The dense network of electrified sand rail lines in the highly urbanized and populated region posed an infrastructural challenge compared to other types of transport. The most significant were the intersections of electrified sand rail lines at level 0 with tram lines. The voltage of the railway network was different to those of the tram network, therefore, the slow travel of the tram was accompanied by the lowering of the pantograph in such a place. On a Polish scale, such intersections were unique, becoming a kind of tourist attraction. The most famous intersection was in the Niwka district of Sosnowiec.

4.2. Functionally "double mining" railway

The essence of the operations of sand railways in southern Poland was closely related to the exploitation of hard coal. It was the needs of the coal mining industry in terms of the supply of backfill sand and the method of underground hard coal mining that determined the directions of development of the sand rail network, the size of the rolling stock and transport, as well as opencast sand mines located in the region. In the

narrowest sense, the type of railways discussed in the article is defined as sand railways, were mining railways, and in the broadest sense, were industrial railways (cf. also CANO SANCHIZ, 2013). The latter term is questionable, due to the fact that mining is included in most scientific research and economic statistics in the first sector of the economy, while industry (processing and manufacturing) is in the second sector (LEYSHON ET AL., 2011; BARNES ET AL. , 2012; BARNES & CHRISTOPHERS, 2018). On the one hand, the term mining industry can be found as a synonym for mining. On the other hand, this term refers to the broad concept of industrialism, also related to the heritage of rail transport. (EDWARDS ET AL., 1996; TILLMAN, 2002; BHATI ET AL., 2014).

The functionally complementary role of sand railways in the hard coal mining process draws attention to their original feature. From this point of view, it was a "double" mining railway, that is, the trains moved between two different types of mining plants – coal mines and backfill sand mines. An even more complicated situation concerns the period of the 21st century, when most of the existing sections of the sand railway were used, not for the transport of backfill sand, but, for other purposes such as the transport of post–mining waste, transport of other goods, sidings of plant's repairing rolling stock. In the 1970s, until the end of the use of backfilling in the hard coal mining industry, these proportions were reversed. Considering the facts in 2022, it should therefore be stated that the former double-mining sand railway is now:

a) a mining railway that no longer transports backfilling sand, i.e. more a "coal" railway (hard coal, coal waste),

b) an industrial railway serving the needs of processing industry plants,

c) a support for the entire rail transport system for the repair of the rolling stock.

4.3. A functional and spatially dual railway

The afore mentioned "duality" of the mining character of sand railways resulted from yet another attribute which could be described as both functional and spatial. One of the types of mines represented opencast mining (backfill sand mines), and the other – deep mining (hard coal mines). It should be mentioned that the network of sand pits and coal mines has changed over time. Until the inter-war period, both types of mining were concentrated in the core part of the region, creating a specific spatial and functional patchwork, however, after World War II there was a tendency to locate new and larger sand mines in the peripheral zone of the metropolitan core. The dual exploitation of hard coal and sand brought with it certain challenges. From the infrastructural and technical side, the loaded and empty trains had to be adjusted to manoeuver within the areas of deep mines and within the filling sand pits. The role of sand railways as a means of transport for transporting post–mining waste was also systematically growing. The waste were also transported independently by mining and industrial railways as well as those belonging to the Polish State Railways (PKP). Nowadays, the transport of post–mining waste is one of the basic attributes of the operation of sand railways. Paradoxically, loaded trains now move from coal mines towards the old sand pits which have been converted into external dumps for post–mining waste, and empty trains move in the opposite direction.

4.4. A mining railway that "does not enter the mine"

An individual feature of the sand railways was the fact that the transport purpose of the lines were unloading bridges (so-called chute bridges) over the mine shafts. In most cases, these were located outside the main area of the coal mine. The area occupied by such shafts isolated from mines by unloading bridges had a small area. The track was located above the sand reservoir in the immediate vicinity of the mine shaft opening. For these two reasons, they were almost imperceptible in the highly urbanized landscape of the region. Shafts with unloading bridges located outside the mines meant that the *de facto* part of the transport operation of the moving train took place outside the fenced area of the mining plant, in the immediate vicinity of zones with other functions – residential, service, other industrial, recreational, as well as agricultural and forestry. These shafts were often located at a great distance from the area of hard coal mines to which they belonged or on the border of the exploitation area of two neighboring mining plants.

At this point, it is necessary to mention another specific feature of the sand railway connected with unloading bridges, which was the quick unloading system for wagons operating in the years 1905–2020 (unmanned lifting of the wagon-bodies with sand[2] allowed for their quick unloading while the train was passing over the chute bridge).

[2] The wagon box was raised to deposit the sand with the aid of special rollers that moved with the movement of the train. The rollers moved along the guides directed upwards, which forced the box to be lifted. After the sand had been deposited, another downwardly directed rail system closed the empty wagon box (https://www.youtube.com/watch?v=JsyUy1FaSVo).

4.5. Functionally "supporting" railway

The originality of sand railways was also due to the fact that, unlike other types of railways serving exclusively, or almost exclusively, freight transport (agricultural, brick, mining in coal mines or railways built for the needs of steel mills and other industrial plants), they performed supporting tasks. Their main goal was to supply sand, which was used as a key component of the backfill for filling underground roadways and shafts of hard coal mines, in mining operations which had been completed. It distinguished sand railways from the above–mentioned types of industrial railways, which were designed to supply raw materials or goods necessary for the production process and to export finished products. Of course, the proppant can be treated as part of the operational process. However, considering the fact that some of the sand backfilling mines did not apply sandy proppant or applied periodically, it was not an indispensable or an obligatory element in the operation of a hard coal mine. In any case, it cannot be compared with deliveries of, for example, iron ore and coke to ironworks or clay in brick factories.

4.6. Mining railroad and company transport for employees

Sand railways had one more original feature in relation to mining railways. In addition to the sand and mining waste transport system, these railways also carried passengers, and more specifically they were the official transport of employees. While the marriage of functions was not original (its employees and other travelers used, for example, the aforementioned Upper Silesian Narrow–Gauge Railway), in the case of the sand railways it was organized in a more systemic way. The sand railway had an organized network of passenger stops with their names, infrastructure, and published timetables. This system, and the entire network, was of a complex nature. Since the 1970s, passenger transport has been operated by the same type of rolling stock that carried passengers on lines serving regional passenger traffic. A specific organizational undertaking was also the service of passenger transport by one of the companies associated with the sand railways (CTL Maczki–Bór), a narrow–gauge tourist line not directly related to mining operations. This line was located in the Silesian Park (then WPKiW) in Chorzów (RUSAK, 2003).

4.7. A railway for mining or for construction?

The pretext for this question was the fact that sand railways (as mining railways) were not included in the typology of freight transport in the monograph by LIJEWSKI (1986). This author considered that the transport of sand was only for construction purposes (LIJEWSKI, 1986, p. 203). Importantly, the presented statement included only sand transported by PKP rolling stock on standard–gauge lines. Backfill sand was omitted as a raw material due to its functional specificity. It is also not included in the description of the transported mining resources. Although the sand railway carried sand for the construction industry, this function was secondary in the 20th century. Nor was it its genetic function. In the 21st century, due to the earlier discontinuation of sand for backfilling purposes, the role of sand supplied for construction in the overall use of rolling stock and networks increased. Returning, however, to the title question about the functions of sand in the transport system, one should see this issue in two ways. Firstly, the backfill sand was, as already mentioned, a raw material obtained in the course of mining. However, if you take a closer look at the use of sand in mining, it can in fact be assumed that it was used as an element of security works, including the construction of underground hard coal mining systems. The underlay as filling was part of a larger containment structure. Nevertheless, backfill sand in a broader sense was a raw material that was exploited for the needs of mining and as part of the mining industry.

4.8. Railway – a bit similar and a bit different

Regardless of the individual characteristics of sand railways, it is also worth mentioning those identical to other types of railways.

Firstly, the transport of sand was carried out both with the network of standard–gauge and narrow–gauge sand railways. The latter were systematically liquidated in the second half of the 20th century, and replaced by a more efficient system of standard–gauge railways. This process was also connected with the increasing distance of sand mines from hard coal mines, which in the case of narrow–gauge railways caused organizational and infrastructural problems. Sand railways were operated similarly to other types of railways by both steam (until the 1990s), diesel and electric locomotives. Diesel locomotives were mainly used for transport in the area of opencast sand mines.

Sand railways went through all stages of railway development, which are characteristic of the railway network in Poland. Firstly, they were created in the three partitioning states (until 1918) as completely independent systems. In the interwar period, there was a partial consolidation between the area of the former partitions, up to the stage of full unification and the formation of a regional system of connections from the mid-twentieth century.

5. Sand railway in southern Poland – an attempt at spatial and functional typology

The sand rail system in southern Poland was an exception among European rail transport systems. A small system of this type functions only in south–western Poland and is related to the mining of copper ore (KGHM "Polska Miedź"). This fact, however, is related to certain typological problems that result from the features of sand railways indicated in the previous pages and their differences from other types of mining railways, including those operating in southern Poland. In order to meet these challenges, a spatial and functional typology was constructed, indicating on the one hand the specificity of the sand railways in the economic system of the region, and on the other hand, some spatial and infrastructural attributes that were equally important in its operation. The model presented in Figure 3 has a structural and dynamic nature and includes sand railways as a sub–type of mining railways and directly compares them with railways operating for the transport of hard coal.

The first level indicates the non-agricultural purpose of this type of transport. The broad term industrial railways includes those serving the manufacturing sector as well as mining railways. These railways can be broad–gauge, standard–gauge and narrow–gauge. As mentioned, it is possible to distinguish between the types of railways that are definitely related to mining operations, and those that were created for the needs of the processing industry. Without going into the details of the division of industrial railways related to manufacturing, at this level, attention has been paid primarily to the nature of the types of mining. Surface mining and deep mining were indicated.

In the case of sand railways, these were definitely for the export of raw material. Until the possible transformation of the former sand pit into a waste dump related to the exploitation of hard coal, the raw material export function was the only one realized in the relation: sand mine – hard coal mine. In the case of railways created for the transport of hard coal, these functions were complex. The basic one was the export of hard coal to contractors. Contrary to sand railways, coal mining railways had other functions – transport of post–mining waste, transport of wood and metal elements. The differences also resulted from the essence of the operation of the mining plants themselves. In the case of sand mines, the raw material (sand) was transported from them. In the case of coal mines, two activities were visible. Transport from the mine (coal, waste) and transport to the mine (sand, construction elements).

Rail transport both in coal mines and sand mines, due to its specificity, also differed in the scope of the so–called places of change of rail transport type. In the case of sand railways, it was a surface zone. The takeover of some of the trains by electric locomotives, from diesel locomotives, operating within the workings, (and earlier also steam locomotives). In the case of coal mining, these changes took place underground and on the surface, and were related to at least 3–stages transport of coal: 1. underground transport (mainly narrow–gauge), 2. transport with hoists and 3. transport by normal and narrow–gauge overground rail. Both the sand railway and the railways transporting hard coal formed railway networks and individual sections. The only coal rail network was significantly smaller than the sand rail network (CIECHAŃSKI, 2018). As mentioned, the latter forms a coherent regional system, while coal railways were mostly sidings or short sections closely related to the PKP railway system.

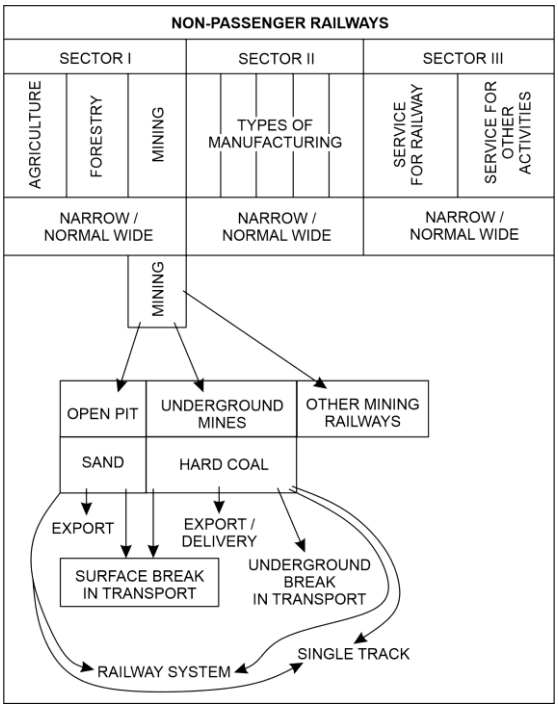


Fig. 3. Typology of non-passenger[3] railways (Source: Author's own elaboration)

[3] Term: non–passenger proposed by Ciechański (2013).

6. Discussion

Sand railways, as CIECHAŃSKI (2018) points out, operated within their organizational, and to a large extent also functional, frameworks until the dissolution of the PMP–PW in 1990. In this year, the most important company managing mining and the transport of filling sand in southern Poland specifically in the historic region of Upper Silesia and western Lesser Poland, had been institutionally split. At the same time (RUSAK, 2001), the hard coal mining abandoned the systemic use of sand filling as a means of protecting the underground parts of the mine. In addition, in the 1990s, the end of the exploitation possibilities was reached by most of the existing backfill sand mines. Although the available resources created the possibility of further exploitation, it was more and more expensive, and above all, in the light of the reduced demand reported by hard coal mines, it was simply economically unjustified, both in the short and in the long term. The sand railway, undergoing rapid restructuring, and in most cases even liquidation, faced challenges characteristic of the entire region in the 1990s and at the beginning of the 21st century (see RAILWAY DEVELOPMENT PLAN ..., 2016).

In fact, the concept of the sand railway, understood as a system of railway lines for the transport of filling sand in 2020, has lost its substantive justification. As mentioned today, they serve multiple purposes: transporting post–mining waste, transporting products from the processing industry, connecting rolling stock repair bases with the generally accessible national rail system managed by PKP. Since there is no transport of filling sand among these functions, the sand railway, as a system, has an industrial and mining (coal) character in relation to the 1st and 2nd sector of the economy and of infrastructure in relation to the 3rd sector of the economy. The liquidation of the last sand rail connection (KP Kotlarnia to Zabrze) is a good pretext for a more general view of the periodicity of freight railways and their strong economic and environmental determinism.

Sand railways, an extremely specialized means of freight (mining) transport, exist only when there is a demand for the raw material transported by them. On the other hand, as the necessary infrastructure of mining plants, they function as a parallel transport system, significantly isolated from the rail transport network based on passenger or passenger–freight transport. Hence, their adaptation abilities in a situation of crisis of genetic functions or economic crisis are weak. This fact, however, stands in opposition to the geographical significance of sand railways in the period of their regression. Theoretically, it should contribute to the adaptation of the sand rail network to new transport challenges. This possibility is indicated by the BEŠINOVIĆ model (2020), which distinguishes three stages as part of the vulnerability of rail transport: survivability, response and recovery.

This was not the case with sand railways, despite the fact that this transport system developed in a highly urbanized region. First, the restructuring and liquidation of the sand railways coincided with the crisis of railways in Poland in general. The regression and decapitalization of the PKP passenger and freight rail network made it virtually impossible to take over the sand rail network. The voivodship self–government had some possibilities, although its efforts were focused mainly on securing the transport and not the railway infrastructure. Only in 2020, as part of the Kolej Plus Program, was a metropolitan project submitted, in which a short section of sand railways would be used for passenger traffic: Bytom Bobrek – Ruda Śląska Chebzie (see MADRJAS, 2020). The path of changes in the sand rail infrastructure is therefore primarily based on endogenous factors – the adaptation of repair and repair workshops by private entities, the use of tracks for the purpose of reclamation and dumping of post-mining waste, and the adaptation of some sections to the needs of industrial plants and mines.

Referring to the essence of the division of freight railways, especially those in southern Poland, whose development was largely based on the transport of mining raw materials, their rather complicated position in the transport system should be noted, but within the context of broadly understood functional and spatial systems. Due to the strong environmental determinism (resources, environmental protection, environmental impact), mining in a different way to the processing industry creates more labile systems of transport links in the spatial and temporal dimension. In the case of sand transport, this variability can be twofold – as a change in the geographical location of sand mines and hard coal mines. The transition of the transport of sand from narrow–gauge to standard–gauge rolling stock, the spatial redistribution of sand exploitation sites, spatial conflicts with other types of land use in a highly urbanized area, changes in the distribution of some unloading bridges and coal mines themselves document the history of changes in the sand rail network, and its regress from the end of the 20th century.

7. Conclusions

Sand railways constituted one of the most important means of rail freight transport in Poland throughout almost the entire 20th century. As a network of mining railways, they played an important role in the functioning of the regional economy on the border of Upper Silesia and Lesser Poland. The decline of the sand railways and the decreasing network of their lines allows us to look at the value of sand railways from a more general perspective – their place in the typology of railways focused on the transport of goods and raw materials. The model proposed in the article places sand railways in the context of their functions and spatial specificity. In the presented typology, sand railways are compared with mining railways which are used to transport hard coal. Both types of railways were inextricably linked with each other. Paradoxically, after abandoning the use of backfilling, some of the sand rail lines gained a new role as post–mining waste disposal routes. As hard coal mining is also to be decommissioned in the region in the coming decades, the existing sand railway lines will face another difficult test of survival.

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