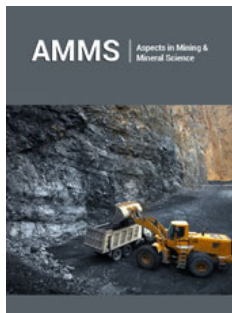


# Monobike-Mean of Individual Transport for Underground Coal Mines

**Pawel Kaminski\***

Faculty of Mining and Geoengineering, AGH University of Science and Technology Stanisław Staszic in Krakow, Poland

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**\*Corresponding author:** Pawel Kaminski, Faculty of Mining and Geoengineering, Department of Mining Engineering and Occupational Safety, AGH University of Science and Technology Stanisław Staszic in Krakow, Poland

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## Opinion

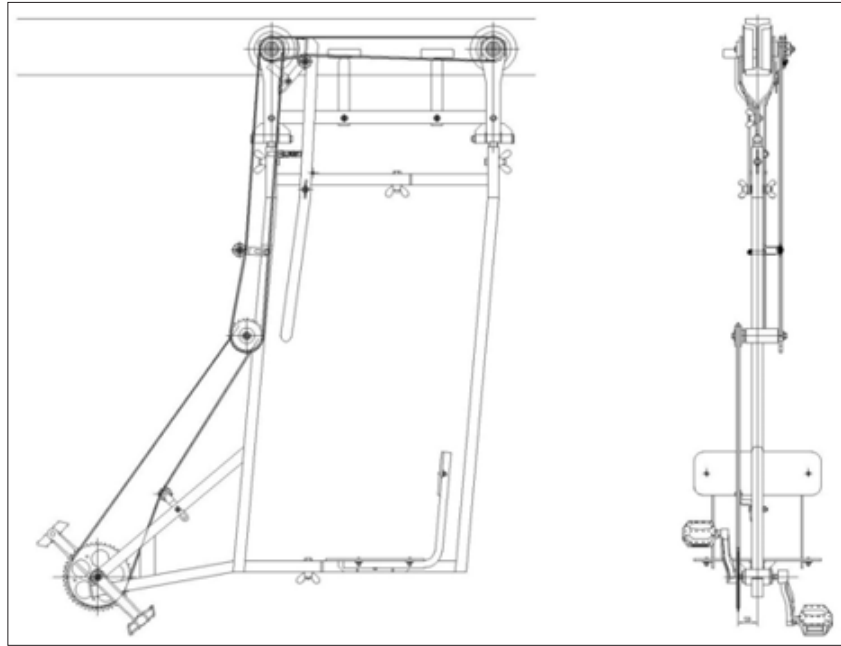
Constant elongation of transport routes in coal mines is a reflection of the mines development process. Since efficient and robust means of transport were introduced in mining industry, this issue might be found irrelevant. In conditions of Polish coal mines, where problems with floor heaving are very common, suspended railways are primary mean of transport. Despite of their suitability to transport people and materials, they cannot be considered mean of individual transport, because of the economic factors. Such situation makes dozens of mine employees walk their way to their workplaces. To raise effectiveness of their work, as well as reduce fatigue of mine workers, idea of Monobike-mean of individual transport for underground coal mines was introduced. The idea of Monobike combines elements of modern bicycles and suspended railways. Such combination of bike and railway for purpose of mine transportation is known from history. However, historic constructions had significant drawbacks, which caused their abandonment. Historic solutions were a kind of “dos and don’ts” in process of the modern underground bicycle design [1-3]. The process of development of the new underground bicycle prototype comprises of six main stages [4]:

- a. Analysis of historic solutions.
- b. Concept of the new construction of the individual mean of transport.
- c. Simulations for purpose of verification of the concept.
- d. Prototype of the new miners’ bike.
- e. Real-life underground tests of the new mean of individual transport.
- f. Analysis of compliance with existing law.

Basing on features listed above, idea of the miners’ bike utilizing suspended railway was developed. It was assumed that the new mean of individual transport should be light enough to be assembled or disassembled by one person. It was necessary to take into account safety of user and environment. The effect of conceptual works on mean of individual underground transport was a patent PL 418208 [5], which was a base for further construction development and necessary research and tests. Specified requirements became a base for number of new miners’ bike construction proposals, which differ by solution of a drive, placement of drive and a seat or assembling of elements [6]. Assembly of the prototype is presented in Figure 1. Analysis of simulations revealed that pressure on pedals equal 200N is sufficient to set bike into motion on the rail with inclination of 0 and 2°. On the rail with inclination of 8° pressure of this value is insufficient and bike tends to slide down the inclination. Maximum speed of the bike with additional load on the rail with inclination of 2° is equal 3m/s. Pressure on pedals needed to set unladen bicycle into motion is 280kN, while in case of the bike with additional load it is equal 375N with maximal load equal 35kg. Maximum inclination of the rail is 10°. In terms of existing equipment of mine workings this value is satisfactory because most of the rails in roadways has inclination up to 8°. Bike ride on rails with higher value of inclination is theoretically possible, but it requires pressure on pedals over 400N, which was recognized too high value [4]. Constructed prototype was tested in real-life conditions to verify results of conducted simulations. First field test was carried out in one of the coal mines of JSW. Tested device was equipped with rubber-coated steel wheels, two side guiding

wheels and transmission gears ratio of 42/16 and 22/16. During the test, mean of individual underground transport was equipped with measuring equipment to determine different parameters, such as linear and rotational velocity, vibrations, or side swing. A view of the underground bicycle during its tests in an underground coal mine is presented in Figure 2. Underground tests of the bicycle revealed several defects of the construction, of which some of them were unnoticeable during simulations, among them transmission gears ratio or weight of the prototype (36kg), which is too high to allow for suspension of the bike on the rail by only one person.

Observations allowed to positively verify a simulation's conclusion, that stability of the bike with a user on the seat is on a satisfactory level. Low centre of gravity minimizes potential lateral swing. Also pedaling does not induce lateral swing. However, there are issues with getting on the bike, especially when the distance between the floor and the rail is very long. Also, chain tends to slip off in corners, because of the frame skew. Shortening of the frame and wheelbase was chosen as the most convenient and efficient way of solving presented problem [4,6].



**Figure 1:** Assembly of the prototype.



**Figure 1:** A view of the new miners' bike during the underground tests.

Historic constructions of underground mines were abandoned among other things, because of lack of their inability to meet law regulations. To not repeat a failure of them, it is necessary to analyse applicability of the bicycle in terms of law regulations existing in Poland. An analysis, which was carried out, showed that the underground bicycle might find application in underground coal mines. Defects listed in this paper were successfully eliminated, but there are still some issues to improve. One of them is a

construction of braking system, which is satisfactory in terms of the prototype, but needs improvement in terms of placing the bike on the market. Simulations, tests and analysis carried out in process of development of the under-ground bicycle allowed to verify its marketable features and find new fields of its development. In favoring conditions bicycle might improve work of miners and help to rise effectiveness of their work. prototype is a subject of further development works.

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