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## Innovative project of prototype railway wagon and intermodal transport system

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### Abstract

A special wagon with a low rotatable loading platform for transportation of truck vehicles by rail was developed in Military University of Technology in the Department of Mechanics and Applied Computer Science in Warsaw. The essence of such reloading is to place the semitrailer on a special rotatable platform with the use of a truck tractor. The structure can be used for transportation of different types of vehicles such as tractors, trucks, trailers, semitrailers and cargo containers. The wagon allows quick and fast loading and unloading without any platform infrastructure or terminals. An intermodal transport system based on an innovative concept of the railway wagon, which will use the national railway infrastructure, was developed. The process of loading and unloading the trailers can be performed considering a whole train or individual wagons from any part of the train (no cranes needed). This type of railway wagon will allow transport companies to save time and money for road transport. The advantages of this construction are reduction of the negative impact on the environment as well as an increase of road safety by reducing the number of vehicles on the roads. As part of the work on the wagon and the intermodal transport system, a strength test of the wagon structure was carried out and the effort of the basic components of the wagon and a complete structure was estimated. For this purpose, numerical analysis was used.

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## 1. Introduction

Intermodal transport benefits in many areas, e.g., reducing of trucks transit time, reducing harmfulness of the influence on the natural environment, reducing the level of damaging public roads by heavy vehicles, increasing capabilities of covering long distances at a time, what is particularly important in the case of transportation of heavy loads, reducing traffic on the roads, increasing safety of public roads, shortening the time of goods delivery to the recipient, among others, owing to lower sensitivity of railway transport to adverse weather conditions (especially during winter time) and elimination of stopovers of trucks at the borders as well as lowering costs of trucks transit. In European railway transport, in recent years, there have been implemented combined systems based on horizontal or vertical reloading or others Kwasniowski et al. (2008). These systems require developed reloading terminals equipped with, for example, vertical reloading devices of accurate load capacity or other expensive and complicated devices enabling loading and unloading activities.

The latest solution, developed recently in Europe, is the system of transportation of truck type vehicles with the use of railway developed by French company Moda Lohr (fig. 1a). This system requires extended infrastructure, especially, railway ramp as well as proper maintenance of the platform devices, particularly in winter conditions. Figure 1 presents a new intermodal systems developed by the above mentioned French company and Megaswing wagon built by Swedish company Kockums Industrier (fig 1b). Megaswing wagon is equipped with a low-loader rotatable platform, which is rotated in respect to an asymmetrically located rotating junction, placed at the rear part of the wagon over its 'over-bogie' part. The other end of the moving platform, shifted outside the outline of the wagon, is equipped with a special running mechanism cooperating with overhanging arms stabilized by hydraulic supports on the surface of the reloading railway platform ramp.



Fig. 1. Wagons for trucks semitrailers transportation: (a) developed by French company Moda Lohr and (b) Megaswing developed by Swedish company Kockums Industrier, [www.\[...\]](#) (2009). [www.\[...\]](#) (2011).

The innovative system proposed in the paper used special railway wagons. In relation to a presently utilized construction of such a type, the presented wagon advantages are as follows; applying repeatable wagons-platforms with an automatic rotating body for fast, safe and easy loading and unloading of trucks, constructional dimensions of the wagon with the load in the form of a semitrailer up to 4 m meet requirements of GB1 gauge, with the special consideration to 130 mm height over the rail head, applying repeatable reloading railway platforms in the form of a system of repeatable segments for quick, easy and safe loading and unloading of trucks without additional crane devices, relatively simple and cheap infrastructure of the proposed system, enabling cheap, ecological and safe transport of truck tractors with a semitrailer with a total length of 17 m, and low exploitation costs of such a system.

A demonstrator of a single wagon with a rotatable platform for an intermodal system on a scale 1:14 was developed in the Laboratory of Materials Strength of the Department of Mechanics and Applied Computer Science, Military University of Technology. The model mapped essential components of the wagon and infrastructure of the loading/unloading railway platform. The discussed model will be used to demonstrate the principle of operation and visualization of basic functions of the railway wagon for transport of trucks. An idea of the intermodal system and simulations of basic functions and loading/unloading operations with innovative railway wagons and used constructional solutions will be presented in the paper.

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