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Perspective directions of planning carrying systems of gondolas

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Abstract
The article presents the perspective directions of gondola carcasses engineering and their features.
Key words: CARRIAGE BUILDING, STREAMS AND ASPECTS OF ENGINEERING

The subject and the results of last researches. Railway transport is the basic industry of the national economy of Ukraine, and the basis of its transportation system, which provides more than two-thirds of the total freight turnover.

Therefore, the theses of the Transport Strategy of Ukraine till 2020 (adopted at the meeting of Cabinet of Ministers of Ukraine on October 20, 2010) and a Comprehensive program of renovation of railway rolling stock of Ukraine on 2008-2020 (adopted by the Cabinet of Ministers of Ukraine on October 14, 2008 No 1259) determine that one of the most important guidelines for this industry is development and operation of freight wagons of our country with modern techno-economic parameters. The gondola park is the most common and demanded. Thereby carriage builders and specialized engineering organizations of our countries start up the research and experimental activities in order to create their own engineering design of gondolas, which will successfully compete with foreign counterparts.

In general we can pick out the following systems [1, 2]: chassis, brake, automatic coupling With a total consideration of the freight car the following main system [1, 2]: chassis, brake,

automatic couplers and body (body combines modules and frames).

Large number of scientific and technical papers is devoted to the definitions, engineering of suspension, brake and automatic coupler systems.

But the analysis of specialized research and reference sources testify that there is no content-date information for the integrated treatment of directions of gondola design support systems of the new generation.

Basing on that we may resume that identification of perspective streams of gondolas engineering and development of the ways to implement them is a complex and challenging scientific and practical problem, which is not dealt enough.

The purpose of the article and the presentation of the material. The article presents the perspective directions of gondola carcasses engineering and their features.

According to the proposed and presented in fig. 1 the general methodology of modern engineering of gondola carcasses, depending on the priority of requirements for products we can pick out the following streams:

- engineering-oriented;
- technology-oriented;
- resource-oriented.

Under engineering-oriented way the priority claims are specific and structural conditions that provide the most effective performance of its functions. The key requirements of such streams include:

- to increase speed of gondolas (fig. 1 par. 1), which is associated with an increase in acceleration and corresponding values of dynamic loads on the elements of the support system;
- to decrease the consumption of materials (par. 2), the possible ways to implement that described in the article [3];
- to improve the gondolas working conditions (par. 3), which combines actions to introduce a new technical solutions in the overall engineering and its individual components, and the use of materials with improved properties (such as aluminum-based alloys and tungsten). The realization of such streams requires special attention to the development and introduction of modern methods of investigation of gondolas working conditions;

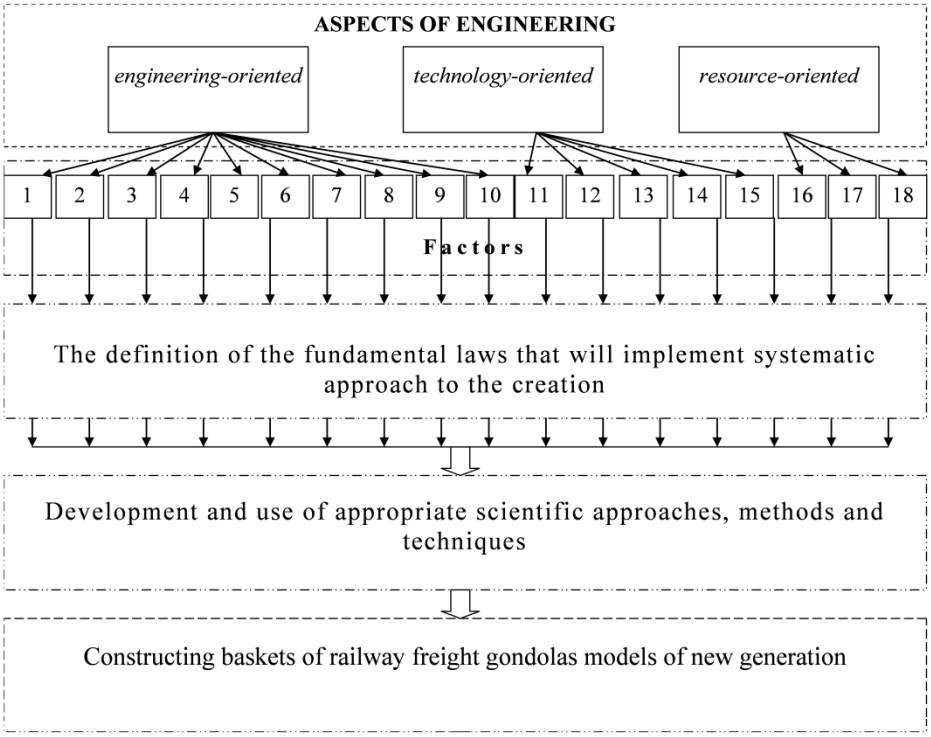

Figure 1. Schematic representation of the modern methodology of gondolas support systems engineering

- to increase the overhaul run and service life of gondolas (par. 4), which is directly related to the quality of used materials and the performance of other parts and components (except module frame and carcass);
- to increase the efficiency in the perception of the wagon loads without damages (par. 5). This is pointed at increasing the energy efficiency of absorbing wagon parts. Also it gives the solutions that provide protection from defects
- to increase the versatility of carrying system (par. 6), for example to transport the hydraulic tanks, so their use as tank wagons, while providing the basic functional properties;
- maximum unification of nodes and multiple carrying systems (par. 7), which significantly affects the reduction of the cost of manufacture and repair of wagons;
- maximum responsiveness of the features of loads to be transported (par. 8). This is the maximum amount of use, carrying capacity, efficient and safe placement and securing cargo, which can be attributed to the peculiarities of the specialization of wagons [4 ... 6];
- to prevent (par. 9) acts of vandalism in the operation;
- to improve the aerodynamic properties of the gondola carcass;

Under technology-oriented way the priority claim is the adaptation of the carcass, operation and maintenance, with a minimum cost for given values of quality. The key factors of this trend are:

- to decrease the number of processing components (par.11) (turning and milling);
- to increase the rate of production and repair of individual components and structures in general (par.12), improving the technological side of industry - procurements (increase punching park, plasma cutting machine and so on), assembly of wagons (improvement of stands, lifting and rotating and the locking equipment, increasing of automated operations and so on);
- to reduce energy and labor costs due to manufacturing (par. 13);
- to reduce energy and labor costs due to repairing (par 14);
- to increase the accuracy and to reduce the complexity of the assembly work and regulation of construction components (par. 15) (pre-load of the cap beam during welding). The realization of technology-oriented streams is inherently connected with the improvement of carriage-building works and railway-carriage repair works.

Under resource-oriented way the priority claim is maximally efficient use of the resource base. It includes the following points:

- adaptation to the industrial base (par. 16), such as accounting of territorial and economic manufacturing capacity or metal foundry;
- waste-free production (par. 17). Taking into account that about 90% of costs in the wagons manufacture fall on the cost of materials and components, and the processing of materials (especially metal-roll), only about 85% is included in the engineering project and the other 15% of the materials to be wasted. This stream is particularly relevant and important. One example of achieving this target is the increasing connect embodiment of elements of ridge beams, walls, side and end walls, leading to a greater use of non-standard length sections (Z-profiles, beams, profiles, top roping, wagon stands, trimming, etc.). Unfortunately they average approximately 7% to 15% and in most cases go to waste;
- to reduce the dependence between car builders and supplier of materials and components (par. 18). One of the priorities is the maximum use of bent and welded profiles instead of special rolling (for example, racks, belts, studs top of roll-formed sections, I-beams in the ridge beams welded construction and so on).

Described points and shown in fig. 1 factors (par. 1 ... 18) for further consideration and elaboration need to define relationships and principles, working out approaches, methods, techniques and implementation models areas of design, with the key criteria. Certainly each direction and logical combinations to some extent have already been worked out by researchers, but the information about the works which would describe the combination of content and links to other areas unfortunately are absent, substantiates the relevance of the work of implementing the deployment of the stream.

Creating of new gondolas up to date can not only be carried out by one of the above and further-developed areas of the complex, without appropriate consideration of other requirements. Therefore, further development of gondolas support systems engineering requires not only a detailed analysis of their key principles and aspects and their subsequent synthesis in integrated project system, which will see the development of competitive gondolas of new generation.

Conclusions and recommendations for future use. The results of the described streams of gondolas engineering and their features allow implementing further scientific and technical work on the creation of national models of new generation with modern techno-economic parameters.

The subsequent development of perspective streams of engineering of support systems (engineering-oriented, technology-oriented, resource-oriented) in the freight wagon building needs, detailed elaboration of which will include the development and use of appropriate scientific approaches, methods and techniques, the definition of the fundamental laws that will implement systematic approach to the creation and study of their analytical and mathematical models, and then combine them.

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