MODERN BALLAST MATERIALS IN HIGH-SPEED SECTIONS OF RAILWAY LINES

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ANNOTATION This statement compares and contrasts data on the changes and differences in the modern ballast materials in high-speed sections of railway lines of Uzbekistan.

Key words: high-speed railway lines, ballast layer, ballast deformation, modern standard design, rolling stock, load–bearing capacity.

INTRODUCTION

For the Republic of Uzbekistan with rapidly developing high-speed train traffic and the possible impact of seismic forces on complex engineering structures such as Railways, it is necessary to ensure reliable operation of the road in this complex combination of loads. [1].

When calculating the strength of a railway track, either stresses and deformations are determined in the ballast prism and on the main platform of the roadbed under the influence of passing trains, or such loads and train speeds at which stresses and deformations in these elements of the track will not exceed the permissible ones. These values are also determined during the feasibility study of the construction of the upper structure of the track [2].

As a result of changes in the physical and mechanical properties of the soil and an increase in the vibration frequencies under the influence of vibrodynamic forces, various deformations and destructions occur in structures [3].

The stability of the footrest under the vibro-dynamic action of the rolling stock is created due to the friction forces between the ballast particles and the soil of the roadbed. The main reason for the vibration of the track is the presence of rail joints and irregularities on the rails and wheels of the rolling stock [4,5].

MAIN PART

One of the main purposes of the ballast layer is to ensure the vertical and horizontal stability of the rail grating when exposed to dynamic train loads. From this condition, the dimensions of the ballast prism are assigned. At the same time, the type of ballast material, the force effect on the ballast layer (depending on axial loads, train speeds, load tension, the nature of the sleepers resting on the ballast), the running weight of the rails, the material of the sleepers and the distance between them, as well as the bearing capacity of the soil of the roadbed are taken into account.

The service life of all elements of the upper structure of the track depends on the ballast layer. If a material with insufficient load-bearing capacity is used for the device of a ballast prism, then a large number of uneven subsidence, shocks, distortions appear, which leads to an increased appearance of contact-fatigue defects in them and even to their fracture. In case of poor condition of the ballast layer, the rubber elements of the fasteners intensively fail, the linings break, defects and fractures of the sleepers appear.

Therefore, increasing the load–bearing capacity of the ballast layer is a reserve for reducing operating costs in the track economy and, therefore, is one of the most important requirements for the ballast layer. In this regard, such a material should be used for ballast, which allows the most high-quality and least laborious to perform straightening work.

The railway track of a modern standard design on reinforced concrete or wooden sleepers ensures its sufficiently reliable operation at speeds up to 250-300 km / h, as well as on lines with high load capacity. However, the applied track design has significant disadvantages under difficult operating conditions, including:

continuous and fairly rapid accumulation of residual deformations; the occurrence of these deformations unevenly along the track; the need for significant labor costs for maintenance and repairs of the track. In addition, this design turns out to be even less rational in tunnels, on overpasses, reinforced concrete and metal bridges, since the engineering structure itself provides a fairly stable base, and an additional layer in the form of a crushed stone prism with less stability sometimes has to be introduced into the area under the rails.

The sub–rail base can also be strengthened by leaving all the elements of the traditional structure of the upper structure of the track - rails, sleepers, ballast. To do this, it is necessary to significantly increase the bearing capacity of the ballast prism. A crushed stone prism treated with a cement-bitumen composition forms a base with intermediate characteristics between a solid monolith and loose crushed stone. The path on such a basis turns out to be more stable than on a conventional crushed stone prism, deformations accumulate in it more slowly and at the same time it is possible to straighten the rail-sleeper grid.

The block-based track on domestic roads and abroad has not yet left the operational testing stage. Most of the structures being laid are either experimental or exploratory, the manufacture of which is significantly more expensive than it would be with their mass production.

When constructing a track on an earthen bed, the device of a ballast prism is necessary, since the soils of the earthen bed have significantly less bearing capacity than crushed stone materials. In this case, elements have to be introduced between the rail and its base (in the area of intermediate fasteners or other part of the structure) to ensure the necessary elasticity of adjusting the position of the rail threads in the profile and plan.

Constructions of block bases of foreign roads. Japan. Even before the construction of the extensive broad-gauge railway network, concrete foundations were used on certain sections of national narrow-gauge roads.

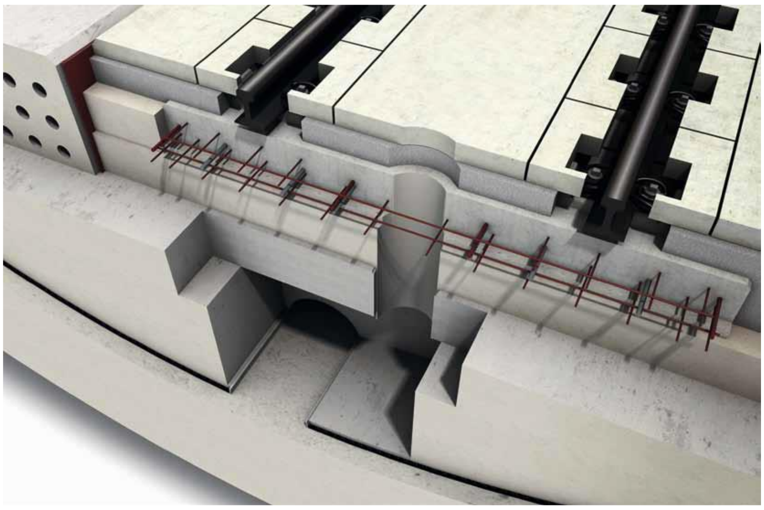

Fig. 1 Construction of a ballast-free path

During the construction of the first high–speed line with standard gauge Tokyo - Osaka, the block base was laid only on sections of short length (25-100 m). The experience of operating the track on this line showed that with typical reinforced concrete sleepers laid on a crushed stone prism, the labor costs for eliminating rapidly accumulating residual deformations were significant. During the construction of this line, it was supposed to pass high-speed freight trains at night.

Comparing the data on the creation of a highly stable track on a reinforced concrete sub-rail base on the roads of our country and abroad, it should be noted some fundamental features in the approach to solving this important and complex task. These features are mainly due to differences in the operating conditions of the lines on which the use of a highly stable path is planned. On foreign roads, the creation of such a track is carried out, as a rule, for high-speed traffic on specially constructed lines, on which the circulation of freight trains is either absent or allowed in very small sizes.

The ballast layer is the least stable element of the upper structure of the conventional path, limiting its overall long-term stability. Therefore, when creating a track on a reinforced concrete sub-rail base on foreign roads, for all conditions of its use, it is considered the first necessity to exclude a ballast layer from its design and switch to a ballast-free path. In this regard, the most important operational and economic requirements are not only the reduction of labor and material costs that justify the increased costs of installing such a path, but also the reduction of time for its installation and maintenance in a constantly serviceable condition.

Experiments show that the occurrence and increase of various kinds of disorders and malfunctions of the track with a reinforced concrete sub-rail base and with the preservation of the ballast layer significantly slows down compared to the usual way. However, due to the greater structural complexity of the path on a reinforced concrete base on a ballast layer, the time spent on repair work to eliminate emerging malfunctions decreases slightly on this path, and the time for laying it even increases by about two times. This is partly due to the lack of track machines for laying and maintaining such a path.

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