

THE SUBSTRUCTURE AND SUPERSTRUCTURE OF RAILWAYS

Djalolova Mohigulkhan

Lecturer at Kokand Railway Technicl School

Abstract: This article provides detailed information about the main structural components of railway tracks — the substructure and superstructure. The substructure includes the ground, the roadbed, and the drainage system, along with their functions and technical characteristics. The superstructure consists of rails, sleepers, fastening components, and ballast, all of which are crucial for the safe movement of trains. The article also covers different types of railway structures, construction stages, technical maintenance, and modern development trends. It serves as an important theoretical and practical resource for specialists in railway engineering, construction, and operation.

Keywords: railway structure, substructure, superstructure, rail, sleeper, roadbed, ground, drainage system, ballast, railway construction, ballastless track, technical maintenance, rail installation, engineering structures, high-speed railways, modern transport infrastructure.

The railway (consists of lower and upper parts. The lower part of the road consists of the ground sheet and artificial structures (bridges, tunnels, pipes, retaining walls, etc.). The upper part of the road consists of a ballast layer, sleepers, rails, fasteners, anti-skid devices, arrow conductors, bridge and conductor sleepers (bruses). The ballast layer receives pressure through the sleepers, It transmits it to the main floor of the ground sheet, smoothes the unevenness of the pressure, and prevents the longitudinal and transverse movement of the sleepers through the relbs, which transmits it to the ballast layer and ensures the mutual stability of the tracks with the relbs. The relbs direct the rolling stock wheels and transfer the weight pressure to the sleepers.

The substructure of the road. Earth's canvas and its cross sections

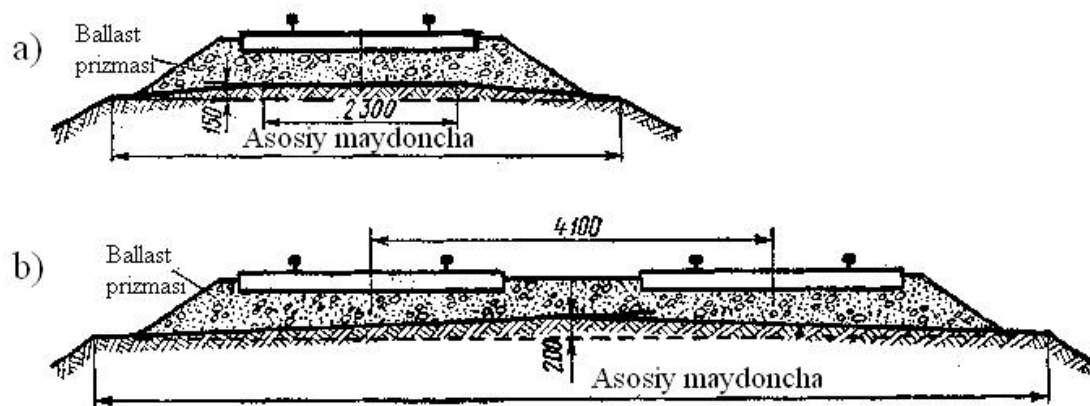
The earth sheet is a complex of soil structures created as a result of working on the surface of the earth. It is intended for placing railway overhead devices, ensuring the stability of the road, and protecting it from the effects of the atmosphere and the railway will not be laid directly to it. The ground sheet should be strong, durable and long-lasting, should have low construction costs, and should have the possibility of extensive mechanization of maintenance and repair work. Fulfillment of the above-mentioned requirements is carried out by the correct selection of the soil composition for the earth sheet, its sufficient compaction during construction, and the design appearance of the earth sheet that repels groundwater and strengthens its slopes.

The section perpendicular to the longitudinal axis of the road is called the cross section of the earth sheet. Sample and individual cross-sectional views of the Earth's crust are different. There can be normal and special types of sample section. A normal earth sheet is built on soils under natural conditions with sufficient strength. Special (individual) sections are used in difficult conditions (permanent ice regions, shifting sands, rocks, sandy and muddy areas, etc.). Individual profiles are used in complex topographical, hydrogeological, geological and climatic conditions, and when the

height of the earth's slope is more than 12 m. All sizes of such profiles are based on special calculations.

The cross-sections of the ground sheet must be in accordance with the construction standards and regulations and the technical conditions of the structure of the railway ground sheet.

The upper part of the ground sheet, where ballast, sleepers, rails are laid, is called the main area. In one-way sections, the upper part of the main platform is in the form of a trapezoid with a width of 2.3 m and a height of 0.15 m, and in two-way sections, it is in the form of an equilateral triangle with a height of 0.2 m. This structure of the main platform serves to avoid rain and snow water passing through the ballast layer.



View of one (a) and two-track (b) railway ground cover

In the drawing, the standard width of the main surface of the earth sheet is given for the roads in use and new construction. In two-way and multi-lane sections, the width of the main area is increased to the value of the distance between the road axes (by 4.1 m in two-way sections, and by 9.1 m in three-way sections).

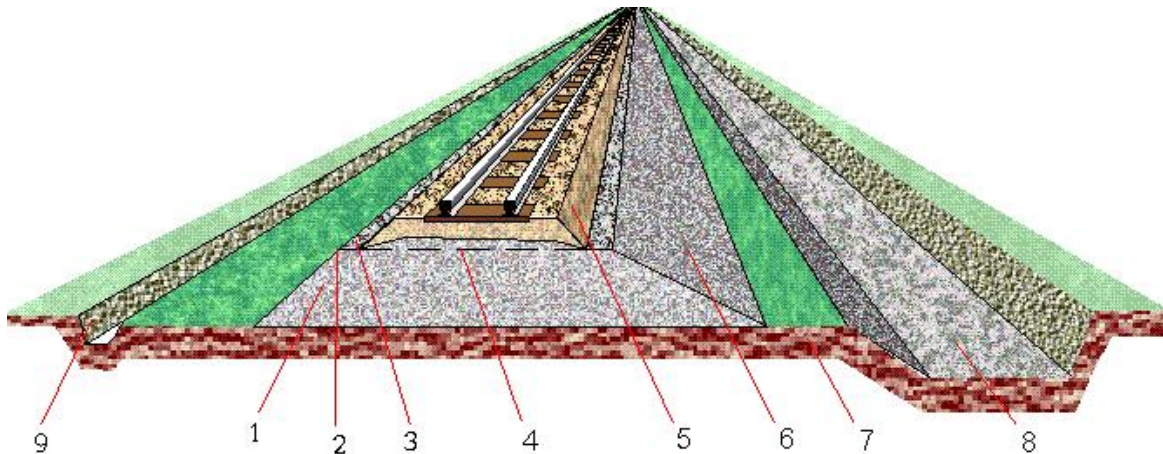
The part of the soil layer that falls on the ground is called the base of the earth sheet. The line of intersection of the main site with the slope of the canvas is called the brow line of the ground canvas, and the line of intersection with the base is called the base of the slope.

The height of the soil layer is calculated from the level of its eyebrow line to the floor along the axis line. Denoting the length of the projection of the slope on the horizontal plane by l , the ratio of the height of the slope (h) to its base ($1:h$) represents the slope of the slope. The slope of the slope is determined by the values that ensure the stability of the earth's surface, depending on the height of the spillway, soil properties, geological, hydrogeological and climatic conditions. In most cases, the slope of the slope is used in the ratio of 1:1.5.

A sample cross-sectional view of the cast form is presented. The surface water of the ground sheet built by pouring soil is drained by means of longitudinal ditches built along the road. The height and bottom width of these ditches are at least 0.6 m, and they are built on both sides of the road in places

with a slope of up to 0.04, and in places with a large slope, they are built only on the side of the ground. If the ground is removed from the ground by laying a road, in such cases, the ground is dug to drain the water

Leveled reserve depths called "reserve" are used.



A typical cross-sectional view of a ground cloth in the form of a pile: 1. Ground pile of a ground cloth; 2- eyebrow line (brovka); 3 - roadside (obochina);

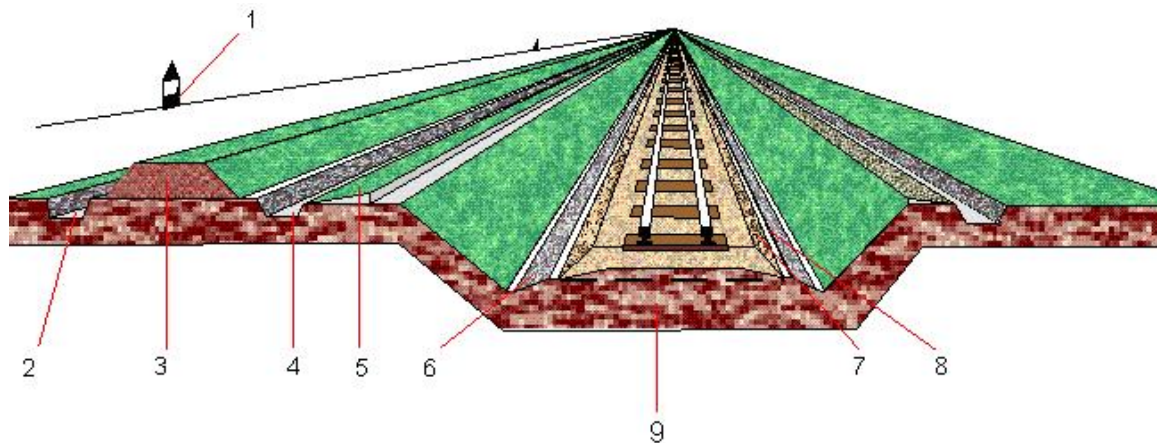
4th layer of sand; 5- ballast layer; 6 slopes (otkos); 7 - berm;

8- reserve (reserve engraving); 9 - drainage ditch

reserve and drainage ditches are built with a longitudinal slope of at least 0.002. The distance from the base of the slope to the spillway or reservoir is called the berm. On one-way sections from the side where the future second road will be built, the width of the berm is 7.1 m, and on the opposite side, at least 3 m, and its top is leveled with a slope of 0.02-0.04 towards the outside.

In this case, the main area of the ground cloth is the same as the cast form. Longitudinal ditches called "cuvet" are built on both sides of the main area, its depth is 0.6 m, the width of the bottom is 0.4 m, and the longitudinal slope is 0.02. If the soil obtained during excavation is not used for the road surface nearby, then it is leveled from the side of the hill to the outside of the excavation in the form of a straight prism, and its name is called "cavalbyer". In order to avoid the water flowing towards the road, a ditch is built uphill before the cavalier.

In the interval from the edge of the carved slope (eyebrow line) to the cavalier, with a slope towards the cavalier, the so-called "banquet" the pile of soil is poured and leveled. An intermediate ditch will be built behind the banquet for water flowing over it and from the side of the cavalier.



Sample cross-section of the earthen canvas in the form of an o`uta (vyyemka).

cross-sectional view: 1 dividing field symbol; 2 hill stream; 3 dunglik (kavalbyer) shed; 4-intermediate ditch; 5- lift (banquet); 6 - railway edge ditch (cuvet); 7 layers of ballast; 8th roadside; 9 - soil dump

In the case of empty soil and poor local conditions, instead of drainage ditches and cuvettes, reinforced concrete, concrete, stone or wooden trays (special ditches) can be built. These trays can be trapezoidal, right-angled, semi-circular and right-triangular.

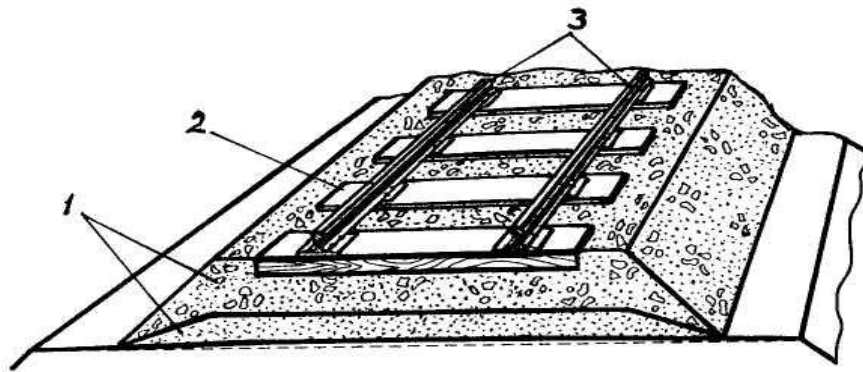
In the station territory, the surface water is removed using transverse and longitudinal drainage devices. In places where people work and walk, such structures are built closed. Collectors and sewage pipes will be built to carry water from large stations, and in oil-rich areas, well sewers will be built. It is planned to build special drainage structures for the purpose of draining underground water or lowering its level. Drainage devices are built in the form of open drainage ditches, trays, closed under-cuvette drains or drainage corridors.

Drainage consists of a trench device filled with well-permeable large sand, gravel, cobble stone (shcheben), and a pipe with a hole laid in the lower part to pass water. The upper part of the drainage is filled with soil and compacted with silt so that the surface water does not fall. Iron on the roads, expanded clay filter pipe drainage structures developed by VNIIT are widely used, and a special machine was also invented for its construction.

. Road surface. Function and structure of road surface devices

Structure. Over-the-road devices are used to direct the movement of the content, to receive the forces of movement through the wheels and transfer them to the under-road. serves to pass.

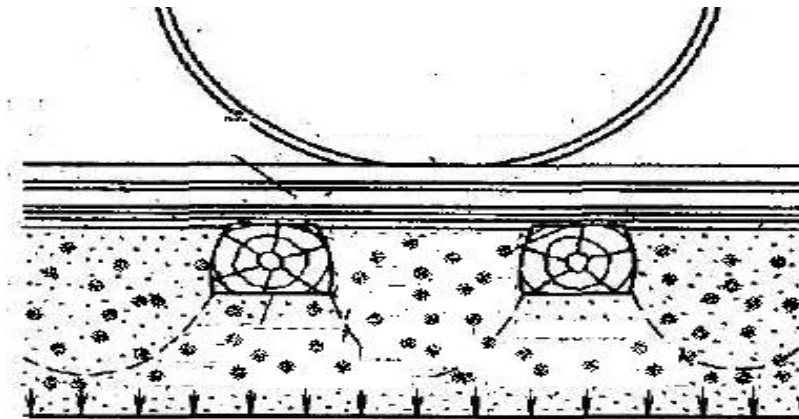
The road surface is a complex structure, consisting of a ballast layer, sleepers, rails, rail fasteners, anti-sliding devices, arrow conductors, bridges and conductors. Rails connected with sleepers form road rails with sleepers. Its sleepers are placed on a layer of ballast laid on the main floor of the earth canvas.



Railway superstructure: 1 schbeben (cobble stone) ballast

and sandy bed; 2- sleepers; 3- relbs and intermediate fasteners

The thickness of the ballast layer and the distance between the sleepers should ensure that it is crushed under the pressure applied to the ground sheet and returns to its original state after the pressure is removed.



The pressure forces of the wheel on the ground canvas
transmission diagram

As the pressure of the rolling stock moves downwards from the junction of the wheels with the road, the impact surface becomes larger and spreads evenly to the surface of the earth's crust with a force of about 0.8-10 kPa.

Road surface devices work in very difficult conditions, are affected by passing trains, precipitation, wind, and air temperature changes, and should be strong enough, durable, long-lasting, economical. There are three types of road surface devices used on main railways, depending on the load of Yo I.

Conclusion

The substructure and superstructure of a railway are closely interconnected. If the substructure is weak, the superstructure deteriorates quickly, compromising safety. Thus, both components must be carefully designed and built using quality materials to ensure durability and safe train operations.

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