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ROAD DESIGN AND LANDSCAPE IN MOUNTAINOUS AREAS

Abstract: *The mountainous relief is characterized by a significant difference in elevation on a short distance, steep mountain slopes, deep meandering river valleys. The geological structure of mountainous areas sometimes changes dramatically in small areas. Mountain slopes are often unstable, and road construction can upset their balance, cause landslides and collapse, and intensify landslides and debris. Special measures are required to protect structures from erosion and destruction The difficulties of carrying out construction work on mountain slopes, their high cost require consideration of a number of route placement options to find the most optimal solution. During the construction of mountain roads, the route usually has to be laid not directly over solid rocks, but along the clayey or unconsolidated weathering products of these rocks covering them. These can be eluvial deposits that remained at the site of their formation, or deluvial-to-alluvial deposits from displaced weathering products.*

Reinforced walls, buttresses and other structures in mountainous areas or in the strengthening of the slopes of the ground canopy should be built on the basis of individual projects

Key words: *mountain-valley landscape, landscape elements, relief, drainage, subgrade erosion, deluvial-alluvial deposits, geological conditions.*

Аннотация: *Горный рельеф характеризуется значительным перепадом высот на небольшом расстоянии, крутыми горными склонами, глубокими извилистыми речными долинами. Геологическое строение горных районов иногда резко меняется на небольших территориях.*

Горные склоны часто нестабильны, а дорожное строительство может нарушить их равновесие, вызвать оползни и обвалы, а также усилить оползни и мусор. Для защиты сооружений от эрозии и разрушения требуются особые меры. Сложности проведения строительных работ на горных склонах, их высокая стоимость требуют рассмотрения ряда вариантов размещения маршрута, чтобы найти наиболее оптимальное решение. При строительстве горных дорог маршрут обычно должен прокладываться не непосредственно над твердыми камнями, а вдоль глинистых или неуплотненных продуктов выветривания этих камней, покрывающих их. Это могут быть элювиальные отложения, оставшиеся на месте их образования, или от делювиально-аллювиальных отложений от вытесненных продуктов выветривания.Армированные стены, опоры и другие сооружения в горных районах или в укреплении откосов грунтового навеса следует возводить по индивидуальным проектам

Ключевые слова: *горно-долинный ландшафт, элементы ландшафта, рельеф, дренаж, субстратная эрозия, делювиально-аллювиальные отложения, геологические условия.*

When laying a route in a mountainous area, one encounters three typical cases of designing a motor road in relation to the surrounding landscape: in the foothills; in the valleys of mountain rivers; on the mountain pass areas.

The principles of tracing the road in the foothills do not differ from those discussed above. The foothills are usually a sloping plain that turns into hilly terrain near the mountains. Depending on the distance of the track from the mountain range, the tracing methods described above in the sections on steppe and hilly reliefs can be used.

Roads in mountain valleys usually connect the settlements located in them with the road network of the foothills or are the initial section of a trunk road that crosses mountain ranges. Their design should take into account the

peculiarity of the mountain-valley landscape: the width of the valley, its transverse profile and the nature of the geological structure of the slopes.

In the lower part, at the outlet of the rivers to the foothills, the valleys are wide. A significant part of them is formed by alluvial deposits, in which the watercourse makes itself a constantly changing position - a "wandering" channel. Wandering channels necessitate the construction of complex bank protection structures, which makes it expedient to use only one method of tracing - laying a road along the lower coastal terrace. Such routes are called constrained in plan, since the longitudinal slope of the road is determined by the longitudinal slope of the river valley, as a rule, much less than the maximum permissible longitudinal slope.

Closer to the upper reaches, the mountain valleys narrow, and their slope increases. The slopes become steeper. Exits of rocks appear on them. High-rise landscape elements begin to prevail so much that disobeying the direction of the road requires the construction of expensive engineering structures.

The design and construction of roads in mountainous areas is associated with a number of complex issues.

The mountainous relief is characterized by a significant difference in elevation on a short distance, steep mountain slopes, deep meandering river valleys. The geological structure of mountainous areas sometimes changes dramatically in small areas. Mountain slopes are often unstable, and road construction can upset their balance, cause landslides and collapse, and intensify landslides and debris. If it is impossible to bypass areas with unfavorable conditions, special measures must be taken to ensure the stability of the roadbed and traffic safety

A significant amount of earthwork during the construction of roads in mountainous areas is carried out in rocky soils, widely resorting to explosive methods. The subgrade on steep slopes has to be built with retaining walls over a long distance

The highly dissected relief of the mountain slopes necessitates the construction of a large number of structures at the intersections of numerous streams and dry slopes. Due to the large longitudinal slopes, even in small drainage basins, storm flows carry stones with them. Therefore, special measures are required to protect structures from erosion and destruction. Difficulty performing construction work on mountain slopes, their high cost requires considering a number of options for laying the route in order to find the most optimal solution.

A plate from the Kamchik pass of the Tashkent-Osh highway.

Natural conditions in the mountains change over a short distance, and the influence of vertical zoning (changes in climatic conditions as they rise above sea level) and the influence of the exposure of slopes in relation to the cardinal points are sharply manifested. On one road, within relatively short sections, natural conditions can vary significantly.

The air temperature in the mountains drops by an average of about 0.5 ° for every 100 m in height. Cold air flows down the slopes into closed valleys. In high mountain areas, there are significant daily temperature fluctuations

Air pressure decreases with height. The difference in marks corresponding to a drop in air pressure by 1 mm Hg ("barometric step") is, depending on the air temperature and atmospheric pressure, from 10 to 17 m. The thinness of air in

high mountain regions causes a decrease in engine power due to incomplete combustion of fuel.

The annual amount of precipitation falling in the mountains increases with the rise above sea level by an average of 40-60 mm for every 100 m of height, reaching a maximum in the zone of intense cloud formation. In summer in the mountains there are intense showers, during which up to 15-20% of annual precipitation falls.

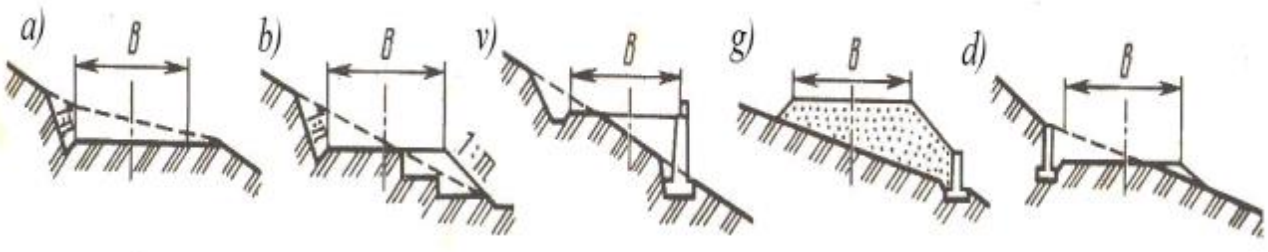
All of these circumstances require careful consideration when designing mountain roads.

In contrast to other types of terrain in the mountains, the choice of route is mainly determined by the location of the mountain ranges and their spurs, which are the watersheds of the river basins.

During the construction of mountain roads, the route usually has to be laid not directly over solid rocks, but along the clayey or unconsolidated weathering products of these rocks covering them. These can be eluvial deposits that remained at the site of their formation, or deluvial-to-alluvial deposits from displaced weathering products.

The degree of development of weathering processes on mountain slopes during surveys can be approximately estimated from the vegetation covering them. Plaques of mosses and lichens are characteristic for the spread of the weathering zone to a depth of 10-25 cm.

A continuous grass cover appears when the thickness of the weathering products is 1–1.5 m, the development of shrubs indicates the spread of weathering to a depth of 1–2 m.



A typical cross-section of the road on a hillside

Sedimentary rocks, folded by layers, often occur in the form of folds facing the bulge outwards (synclines) or upwards (anticlines). There are various seam inclination from horizontal to nearly vertical, fracturing, shears and faults. Layers of limestone or sandstone can be separated by interlayers of clay, when saturated with moisture, shifts are possible - landslides of the overlying layers. The most unfavorable for road construction and requiring careful assessment of geological conditions is the location of the weakening surfaces with an inclination towards the slope.

The degree of influence of climatic factors on mountain slopes is determined by their exposure to the cardinal points and steepness, on which the amount of heat received depends. The southern and southwestern slopes are well warmed by the sun. Their weathering is more intense. On them, talus is more often formed, snow falls and mudflows occur. These slopes are cleared of snow more quickly and there are less groundwater outflows and landslides on them.

On the northern and northeastern slopes, snow sometimes persists until early summer.

In short, in mountainous areas, the formation of vegetation-grass cover on the side slope surface to strengthen the footpath. It is the simplest reinforcement, in some cases it is strengthened by planting trees and shrubs on the side slopes. The soil layer can be processed with a binder and reinforced with some reinforced concrete elements, cement or asphalt pavement. The most common

and effective measure is to plant grass to form a layer of vegetation. It is usually made of prefabricated reinforced concrete elements

Reinforcers consisting of Such structures are usually used to reinforce deep carvings or high lifts. The formation of a protective layer of prefabricated or monolithic reinforced concrete is usually used on paved road sections, leading to bridges. In mountainous areas, pneumatic concrete is used to reinforce the slopes of irradiated rocky soils. In mountainous conditions, on clayey or sandy soils, the slopes of the uplift and carving are often reinforced with layers of rock material of different thicknesses or gravel.

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