Temporary and operational transport roads in construction of transfer linear structures and their scientific and technical support

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Abstract. Due to the economic and technical progress of countries and regions in Europe, the necessary and possible transport communications, power lines (power lines), various pipelines and other linear structures were laid through the Alpine Mountains. The Caucasian Mountains in this part are strongly lagging behind. The railway crosses the Main Caucasian Ridge (MCR) only in the western part up to the Black Sea coast, and the automobile road is in the Central part through the Cross Pass along the Georgian Military Highway and the Roksky Pass along the Military Ossetian Road. The Gas pipelines and power lines were laid in the same areas. At the beginning of the 11th century, the Dzuarikau - Tskhinval pipeline was laid to provide gas to the population of South Ossetia. In the peak position this gas pipeline is the highest one on a global scale being of a particular organizational interest. Of the same interest is the construction of a road through the Roksky Pass, hereinafter referred to as Transkam. Organizationally, these two linear structures had to be laid on the automobile road as a temporary one and a technologically advanced soil and gravel road on the gas pipeline at an absolute height of more than 3,000 meters. These roads have important social, economic, agricultural and strategic importance which is considered in this article.

1. Introduction
When designing and building transhipment railways, highways, gas pipelines, power lines, it is necessary to lay temporary access roads to ensure transport links between the production sites and the coordinating center independently on the opposite slopes [1-4]. In common practice, for example, during the construction of the Transkam through the Roksky Pass, temporary «pioneer roads» were designed and built independently for the northern slope of 20 km and the southern one of 33 km.

During the active construction process, there was a need for a dirt road through the Main Caucasian Ridge (MCR) to transfer construction equipment from site to site. In the northern section the earthmoving equipment was idle but in the southern section it was not enough.

Previously a unit of tracked vehicles was diverted via Baku or Sochi: the northern section of Zaramag – Alagir – Beslan – (by car on a trailer) – Beslan – Baku – Tskhinval by rail and from
Tskhinval to the southern section – also by car, which took about 2 weeks using the locksmith-automobile link. The experts in terrain conditions proposed to lay a 13 km dirt road through the MCR separating the organizational and administrative production road sections. The proposal was based on the economical and mathematical methods, taking into account the determination of energy costs for transporting road equipment by rail and the cost of constructing a dirt road using the formula:

\[ E = \sum_{i=1}^{n} N_i \eta_i t_i \]

where \( E \) - energy consumption for the work performed;
\( N_i \) - the number of equipment units used to perform the work (in units);
\( \eta_i \) - engine power of the applied equipment (in HP);
\( t_i \) - equipment usage time (per hour).

According to calculations, it was determined during that Transkam construction, the cost of a dirt "service road" building was paid off within 1.5 years and it could be used for the entire period of the road of and the main tunnel construction, which took about 7 years. During these seven years, the problem of imbalance in earthmoving equipment between sites was removed. The bulldozers «Komatsu» and «Caterpillar» easily extended the Main road and after 5 hours began the work on the other slope.

For the same period, this road was prescribed to be used «for the needs of agriculture, for example, for driving livestock to pastures, using hay lands, as well as for tourism purposes».

Following the completion of the first stage of Transkam, the problem of laying power lines and looping the North Caucasian and Transcaucasian electric networks arose. The designers took advantage of the presence of the road and the power line was laid a direction through the MCR along the Magsky pass.

During the war in 2008 in South Ossetia, the transfer of the military units to Tskhinval in order to force the peace for the Georgian army troops was carried out through the Roksky tunnel. The service road under consideration could be an option for the transfer of such troops in the event of the Roksky tunnel portals destruction. Thus, the strategic significance of such roads should not have been ignored.

**Figure 1.** A schematic plan of Magsky tractor roads

They could have a significant role in the development of tourism. In Soviet times, there was an all-Union pedestrian tourist route along the MCR along the path through the Roksky pass, which was canceled due to dangerous movement conditions along a narrow path and the occurrence of a tourist's
fall down the slope with a fatal outcome. This route may well be used via a service tractor road where high – traffic vehicles can be brought to any point of the pass section. The scheme of the considered and promising use Magsky tractor dirt road is shown in Figure 1.

2. Materials and methods
The paper uses data obtained during the study of the gas pipeline between North Ossetia and South Ossetia.

3. Analysis of the gas pipeline between North Ossetia and South Ossetia functioning
Comprehensive studies of the gas pipeline between North Ossetia and South Ossetia were conducted [5-10].

The Dzuarikau – Tskhinval gas pipeline was laid through the Alagir district of RNO-Alania and the Dzhava and Tskhinvali districts of the RNO – Alania region in the Central part of the MCR near the borders of North Ossetia and South Ossetia on the Kudar pass at an unprecedented height of 3148 m above sea level. The length of the pipeline route is 168.7 km laid in particularly difficult mountain conditions. The Dzuarikau – Tskhinval gas pipeline is not the first line through the MCR. In Soviet times, the Stavropol – Tbilisi – Yerevan gas pipeline was built along the historical Georgian Military road through the Krestovsky pass at an absolute height of 2495 m which is almost 0.5 km lower than the Kudar pass.

The altitude position of the Dzuarikau – Tskhinval gas pipeline is shown in Figure 2.

![Figure 2. Longitudinal profile of the gas pipeline](image-url)

The gas pipeline plan and gas distribution stations (GDS) is shown in Figure 3.

The gas pipeline under study is the highest in the world. Its end sections on both sides of about 18 km are laid in flat conditions, then the route of about 40 km in the South is laid in mountainous conditions, and in the North in the cramped conditions of the Ardon river and the middle part of the
gas pipeline from Kobet to Chiba about 50 km passes in particularly difficult mountain conditions. The strip of the gas pipeline of Tskhinvali to Kvajsa and from Dzuarikau to the planned construction of a tourist complex «Mamison» is laid using relatively perfect and safe access roads.

![Diagram of gas pipeline and road network](image)

**Figure 3. Dzuarikau – Tskhinval gas pipeline plan**

On the remote mountain sections, the track works on a dirt and gravel road attract special attention. On the northern slope the future mountain tourist complex «Mamison» is located directly at the beginning of a complex section of the operating gas pipeline and after the introduction of this tourist complex. The necessity of a convenient exit to the South, towards Kvajsa and further to Sachkhere and to Kutaisi via Oni – Ambrolauri, will appear. The Western Georgia, Abkhazia and even the Turkish Black Sea coast will become points for these routes attraction.

Taking this in mind the future significance of a particularly remote mountain section, a dirt and gravel road and the gas pipeline itself should be laid on this section with as few slopes with a small radius on curves, which would be possible with scientific and technical support for the road safety project [11-15]. This would give more opportunities for the rapid implementation of transport links between the tourist and recreational complex and transport routes in the south-west direction.

Figure 4 shows fragments of the complex sections of the operating gas pipeline road that are technically, technologically and topographically available for reconstruction in order to transfer the road to a safe channel for the road traffic, taking into account its operation as a seasonal – summer one. And for year-round operation, laying a tunnel in the technical terms is not particularly difficult.
Figure 4. Fragments of road sections along the Dzuarikau – Tskhinval gas pipeline

4. Conclusion
Thus, the above-mentioned positive aspects in the use of the dirt service road through the Magsky pass in social, agricultural, tourist and strategic terms will certainly be implemented on the operated road of the Dzuarikau – Tskhinval gas pipeline. In addition, if it is brought to a safe state, it can become a route of attraction for all the countries of the Black Sea coast from Sukhum and Batumi via Kutaisi-Kvajsa to the future Mamison tourist complex.

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