Geographical spread of the Euro-Asian high-speed railway of Paris-Delhi through the Caucasus and the prospect of its construction as an International Transport Corridor
Kortiev L.I., Kortiev A.L.


The monograph provides a geographical context of the New Transport Corridor – the Euro-Asian high-speed railway of Paris-Delhi through the Big and Small Caucasian Ridges, which has more than a century of history and is the main axis of the world, and good-fellowship on two continents. The railway in all countries should be under the authority of and committed to the United Nations organization. The suggestions on how to lay it in organizational, technical and economic terms are outlined.
## Contents

1. Statement of purpose .................................................. 4  
2. Historical perspective and economics of the high-speed railway ......... 4  
3. State of the new transport construction in Russia ........................ 6  
4. Trans-Eurasian high-speed railway (TEHSR): reality or myth? ............ 7  
5. Problem of the high-speed railway in Russia (Caucasus direction) ...... 10  
6. Future principal lines of the TEHSR and introducing a high-speed railway traffic .................................................. 15  
7. Problem Caucasian section of the TEHSR Paris-Delhi .................. 18  
8. Significance and intersections of the TEHSR with the lines of the EU and Russia transport corridors .................................................. 23  
9. Desired investments for introduction of TEHSR. ........................ 24  
References ............................................................................. 27
1. Statement of purpose

The era of modern transport construction is characterized by the development of high-speed transport links. These days, high-speed rail transport is able to meet competition to the air transport. The achieved average speeds of trains of 300 km/h, causing a drastic reduction of transit time, increase in comfort, inexpensiveness of travel and transportation of goods, convenient location of train stations within the city and relatively convenient nearing to the departure and alighting station push aside the air transport.

The record speed of about 500 km/h on the railroad speaks about future of its relevance. Unlike in the past, when in each state rail transport developed autonomously, now it is going on according to a civilized manner, for the countrywide and inter-country unions have been established to develop high-speed rail transport what.

High-speed lines in Japan have been developing for more than 40 years and their length, relative to such a small country, exceeds about 1000 km. At the design stage, they were provided with a speed of 250 km/h, but they are so ideal that trains can travel at a speed of 300–350 km/h. At the same time, no one was killed or injured by railway accidents for so long and the average train delay is only tens of seconds!

2. Historical perspective and economics of the high-speed railway

In chronological order, high-speed lines have been developed in Western Europe – in France, Germany and Spain. The speed of 300 km/h on the lines has become so commonplace. The high-speed railway line constructed in France in 2001 with a length of 250 km between the cities of Marseille and Valença shows the latest achievement in science and technology. In order to protect the environment, to mitigate the environmental impact, and to flat the line, we had to excavate tunnels and construct bridges and overpasses with a total length of about 30 km. Thereby, the average cost of 1 km of the open road cost the French treasury about 15 million dollars.

Increase in speed and comfort, 200% greater cheapness of travel and reduction of transit time attract passengers to this mode of transport. Tendency of pushing aside the air transport by high-speed railways is increased by the movement of passengers in a radius of about 600–800 km. This tendency is represented on the Paris-Lyon-Marseille high-speed rail line, where the airline operates in parallel with, suffering damages accounting for about 25%.
Relations between states in terms of development of the high-speed rail-ways between France and Spain, France and Italy are rapidly developing. England, Belgium, Germany and Holland are lined up with such transport links. A 280 km road is being constructed on the high-speed line through the Alps between the cities of Lyon (France) and Torino (Italy). The average cost of 1 km of the road is about 35.7 million dollars. In terms of Russian conditions (for the Caucasus), the cost of a highway through the same mountain conditions with a length of 57 km and a tunnel with a length of 4 km cost 120 million rubles (at that time dollars and rubles exchange were almost equal). By the example of railway construction, the following comparison can be made.

In 1983, the Caucasian railway under the main mountain range was determined at the cost of 1.110 million rubles with a construction length of 178 km, including tunnels – 42 km, by the last project of “Kavgiprotrans”. Consequently, 1 km of the railway in such alpine conditions was planned to be built for 6.2 million rubles, i.e. 6 times cheaper.

At this time, both abroad and in our country, the idea of high-speed lines construction has been rapidly developing. Therefore, the travel time from Lyon to Torino will be reduced from 4 hours to 1 hour 30 minutes, cover a distance of 280 km. In our conditions, for 1 hour 30 minutes along the ideally flat road Vladikavkaz – Rostov you will not reach the station Prohladnaya (70 km), and it will take about 5 hours to cover a distance of 280 km.

In Italy, reconstruction of the railroad in high mountain conditions, where of the total length of the road with a length of 90 km, for tunnels and other engineering structures accounts for 78 km. This is similar to conditions of the Caucasian railway under the main mountain range construction.

In the countries of Central and Southern Europe, there is a revival around the ideas of high-speed rail lines. In Poland, the Warsaw-Katowice line has been reconstructed for high-speed service; in Greece a high-speed operation between the cities of Athens-Thessaloniki is started, and in Macedonia, there is a line to the border with Bulgaria. In Turkey the high-speed rail line Istanbul-Ankara was constructed.

China actively cooperates with European companies in terms of rapid development of the high-speed rail lines.

High-speed rail lines that transcend national borders have drawn nearer to the borders of Russia and the CIS countries. The high-speed rail lines around Russia considerably cut the time. Like the railroad, highways are being introduced into the global community practice as International Transport Corridors, however, losing at the borders and customs bottlenecks more time than on the
railway tracks. Notwithstanding, then as mutual trust and civilization comes, this issue would fade away by itself.

Tunneling on the main transport routes also succeeds.

Scientific and technological progress in rail transport in the USSR also kept pace with the world level of development. The pursuit of high speeds began in our Homeland, and even at that time, scientists and practitioners achieved certain successes. In 1966, on the section of the Gryady — Malaya Vishera railway, the speed of 200 km/h was achieved for the first time on the electric locomotive CHGS, and now, trains are racing at a speed of 250–300 km/h on the Spanish and French lines.

### 3. State of the new transport construction in Russia

Travel ways in the common transport system are gradually being modernized. Along with many technical features of the railways, always the first was the need to increase the train speed, as one of the main factors for the economic development of the industry. Saving time for passenger travel is a social necessity. This factor is the main one, when choosing the mode of transport. When traveling to a distance of 20–30 km due to social and living conditions, preference is given to road transport; if this distance is more than 100 km, preference is given to trains. For a distance of more than 1000 km, the passenger chooses air transport, even in conditions of inconvenience and loss of time before boarding and when receiving baggage. On high-speed lines in Western Europe at medium distances (600–800 km), the high-speed lines are able to meet competition to air transport. For cargo transportation, the preference has always been given to the railways, even at low train speeds.

In increasing of speed on the railway, its change over from the locomotive and petrol-electric tractions to electric power operation is particularly important. Electrification of railways within our country began in the Caucasus, where it was further spread to the USSR from. It was a good base for the development of high-speed operation. In 1965, the first tests were carried out on the Moscow-Leningrad section of the railway, as the most flattened and meeting the requirements for the development of high-speed operation. At that moment, the train reached a speed of 160 km/h.

The concept of high-speed running in the 80s of the XX century was taken up in all interested scientific and design organizations of the USSR. Discussions began on the project of high-speed railway Center-South, developed by the Mosgiprotrans and Lengiprotrans design institutes with the participation
of research institutes of the Ministry of Railways and Ministry of Transport Construction of the USSR. The high-speed line was guided to the Crimea and the Caucasus, as it was suggested at the beginning of the development of the railway in Russia in the middle of the XIX century. Although, in the Caucasus, the Greater Caucasus Mountain Range was inaccessible to the Russian railway, and it circumambulated this range, rerouting a shipment of about 1,000 km, causing the greatest damage to the national economy as a whole, the Caucasian economic region.

The high-speed line has been lively discussing yet in the time of the normal development of the country’s economy, aimed at the Caucasus, would have to struck by straight arrow the Greater Caucasus Mountain Range with a ways that brings profit to the economy and passengers – saving time and travel comfort.

In 1986, the United Nations organization adopted the European Agreement on High-Speed Rail Lines, which was joined by the USSR two years later, but this time was fatal for the Soviets country and its economy: the country began to collapse. At that moment, the USSR’s transport construction by inertia reached its height in the construction of the Caucasian railway under the main mountain range, where the future high-speed line was oriented guided to the Caucasus from Moscow. Detailed study and analysis of the Caucasian railway under the main mountain range of this period shows that this direction did not meet the future high-speed operation, since it as closely as practicable passed round designed “North-South” direction in Tbilisi from the Russian center, did not reduce the amount of work and, respectively, the cost of construction. To make things worse, it was not perfect in terms of safety from slope conditions during operation, and in construction organizational terms.

4. Trans-Eurasian high-speed railway (TEHSR): reality or myth?

Without politics, the TEHSR is a reality. In the normal course of peaceful relations between the EU and Russia, as was in the recent past, we may start discussing the TEHSR at all levels of organizational, political, financial and other aspects. Ukrainian and earlier Georgian events, warmed by the active influence of the United States, drew Russia in a process of stressed state of the EU and Russia, which set aside the discussion of the problem for a while. God will decide who is to blame for the breakup of Ukraine. And, in TEHSR problem, today’s one or tomorrow’s two, Ukraine will not play a key role. The road is considered
a single object under the aegis of the United Nations, its Charter and stringent laws on operation on both continents of Europe and Asia.

Figure 1. TEHSR suggested to be implemented in two stages

With the advent of peace in Ukraine and in Georgian-Russian political relations, it will be possible to start discussing the theoretical plan of TEHSR as a peaceful “steel-linked” Europe and Asia. At the same time, organizational, economic and transport problems should move away political and Nazi slogans and emotions for shortening of distances and mutual respect between Delhi and Beijing with Paris and Helsinki. Geography of transport links between the countries of Europe and Asia by the TEHSR is shown in Figure 1.

At the first stage, Paris is linked with Delhi, and at the second stage, Beijing-Delhi, Paris-Lisbon-Helsinki-Moscow-Vladikavkaz and other geographical directions should be linked. Distances and travel times between the countries’ geographical stations, taking into account the trains speed of 300 km/h and a down time of 10 min for passengers loading and unloading, are shown in the table.
Table 1. – Table of the approximate distances and times of train movements between stations in large cities on the TEHSR Paris-Delhi

<table>
<thead>
<tr>
<th>Station</th>
<th>Distance (km)</th>
<th>Time (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paris</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Berlin</td>
<td>726</td>
<td>2.42</td>
</tr>
<tr>
<td>Warsaw</td>
<td>1199</td>
<td>3.9</td>
</tr>
<tr>
<td>Kyiv</td>
<td>1837</td>
<td>6.1</td>
</tr>
<tr>
<td>Rostov</td>
<td>2630</td>
<td>8.7</td>
</tr>
<tr>
<td>Vladikavkaz</td>
<td>3250</td>
<td>10.8</td>
</tr>
<tr>
<td>Tbilisi</td>
<td>3428</td>
<td>11.4</td>
</tr>
<tr>
<td>Erevan</td>
<td>3624</td>
<td>12</td>
</tr>
<tr>
<td>Bagdad</td>
<td>4174</td>
<td>13.9</td>
</tr>
<tr>
<td>Ahvas</td>
<td>4684</td>
<td>15.6</td>
</tr>
<tr>
<td>Bandar Abbas</td>
<td>5574</td>
<td>18.5</td>
</tr>
<tr>
<td>Karachi</td>
<td>6324</td>
<td>21</td>
</tr>
<tr>
<td>Delhi</td>
<td>7474</td>
<td>24.9</td>
</tr>
</tbody>
</table>

4. Trans-Eurasian high-speed railway (TEHSR): reality or myth?
5. Problem of the high-speed railway in Russia (Caucasus direction)

Our scientists had developed a project of the high-speed railway from Leningrad to Moscow and then to Yuzhnoye, including the Caucasus direction, by the end of the Soviet era. The final points in the Caucasus are Sochi and Mineralnye Vody (Fig. 2). Then absolute uncertainty came.

That was at the very beginning of the development of the Russian railway in 1870, when it reached Rostov-on-Don and had no further prolongation. This
uncertainty dictated the subsequent direction of the Caucasian rail road around the Greater Caucasus Mountain Range and instead of the direct route from Vladikavkaz to Tbilisi with a length of 200 km, it was the unnecessarily long transportation of cargo of 1000 km, during one century, that cause economic damage amounting to the sum, which a direct rail line could be built between Vladikavkaz and Tbilisi with the tunnel crossing of the Greater Caucasus Mountain Range for.

At this stage, from a defined in the design studies station “Mineralnye Vody”, a high-speed railway should be constructed by a direct line to the station “Prokhladnaya”. From Prokhladnaya to Tbilisi, the future line should be relatively flatted under the Greater Caucasus Mountain Range. The tunnel portals should be located below the line of snow-avalanche danger. It should not be afraid of long length of the tunnel, as tunnel-boring machines can easy operate in technical and technological terms.

Selection of a long tunnel makes the road safer and more comfortable.

In the future, taking into account construction of the road in long tunnels, variants are identified that facilitate flattening of the route throughout the Caucasus section of the TEHSR. Cartographic and reconnaissance detailed studies throughout the Caucasus in the Central part defined various feasible variants; a plan for one of the variants is shown in (Figure 3).

In technical, technological and environmental aspects, this line has a number of advantages in comparison with other variants, as it has a number of possible options for approaching the open surface. In light of its laying in tunnels:
- the rail road move from the mountainous category to the plain one;
- impact of construction activities and operation on the environment becomes minimum.

The basis for the method of searching for this variant was the desire to trace the tunnel centerline without limiting its length, i.e. passage the mountain terrain throughout the Greater Caucasus Mountain Range by a tunnel.

In the age of tunnel-boring machines and use of modern tunneling equipment, it becomes possible to solve already-existing problems in tunnelling under different mining-and-geological and hydrogeological conditions. The geological structure along the line of the proposed route consists of lime-rocks, slates, sand rocks, marls, gneisses, granitic rocks, etc. It should be expected that during the tunnel construction special mining-and-geological and hydrogeological complicating conditions will not be found. At the same time, it is necessary to develop the most profitable scheme for managing the use and transportation of the rocks mined in the tunnel. The mined rocks – hard stones and sand – can be used as a construction material, and the rest of the soil mass is for dumping the roadbed.
Figure 3. Scheme of the proposed flattened TEHSR at the Caucasus section
The railroad crosses a number of splits and thrusts. According to the data of Sevosgeologorazvedka, in the mountainous part of North Ossetia, 13 km from the Greater Caucasus Mountain Range there are 7 splits and 2 thrusts, lining from the East to the West. One of these splits – the Khalatsin split zone – is intersected by the Rokski traffic tunnel, which, when constructing and operating, does not create perceptible interference at an altitude of 2000 m above sea level. The proposed railroad line will cross the Greater Caucasus Mountain Range at an altitude of about 1300–1400 m, which is more than 500 m below the Rokski tunnel, and the conditions for crossing these splits should be smoother than in a case of motor road.

When crossing splits and thrusts by the mining method (drilling-and-blasting) in domestic practice of tunneling, the tunnel lining is reinforced as per calculations or structurally – with reinforced concrete or metal in order to increase its bearing capacity. In the shield method of digging by the shaft-sinking and tunneling equipment, we should focus on the theory and practice of examples of the Alpine and other mountainous regions of the world.

Figure 4 shows a longitudinal plan of the TEHSR from the station Darg-Koch to the borders of Armenia and Turkey

In order to protect the environment, construction should be carried out according to the following technological chain: erection of formation should not be made from the initial and final sections of the work, as is usually in the conventional construction technology, but from the location of the tunnels portals. Nevertheless, priority was given to start tunneling and use the shifted rocks for the construction significance and characteristics for dumping the roadbed or sand and hard stone for concreting. Thus, the construction of road and tunnel is starting out from the points of the tunnel portals, taking into account the maximum use of the rock shifted from the tunnel. The modern practice of the technology of domestic open and underground construction using by the example of tunnels is introduced according to a scheme of processes isolated from each other – from zero points that creates conditions for undue interference in the environment and environmental abuse.

At the present stage, Russian engineering advances and science stand at the parting of the ways, where the promising direction of the high-speed railway or prolongation of the North-South international transport corridor from Sochi and Mineralnye Vody will be lined.

Movement of transit cargo from the Northern part of European countries and European Russia to the South Asian countries is carried out on the following route: from Northern and Eastern Europe by Russian motor and rail road
to the port of Olya near Astrakhan, then by ferry across the Caspian Sea from the port of Olya to the port of Anzali in Iran by sea and then by road or railway transport to the Gulf countries and to India by sea, rail or road transport.

Figure 4. Schematically concise profile of Caucasian section of the proposed Euro-Asian high-speed railway

Table 2. Of tunnels length

<table>
<thead>
<tr>
<th>No. of tunnel</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length, km</td>
<td>57</td>
<td>6</td>
<td>33</td>
<td>5</td>
<td>42</td>
</tr>
</tbody>
</table>

In fact, change of mode of transport in the human mind is a rather wearying process and result in the loss of a huge amount of time. For a specific judgment, we consider the concept of the time necessary during transportation of cargo conditionally from Moscow to the Persian Gulf. From Moscow to the port of Olya, the distance on motor road is about 1.460 km, which is required about 20 hours at a normal speed of 70 km/h. Travel by sea from the port of Olya to Anzali requires 68 hours, and travel from Anzali to the Persian Gulf with the distance of about 1600 km will take 23 hours. Total estimated actual travel time, excluding stops for rest, feed, servicing, transhipping and loading is 111 hours. Taking into account loading, unloading and execution of documentation that
takes of about 20 hours, the delivery time is approximately 131 hours or more than 5 days. If, on the conceivable proposed high-speed railway, the cargo is transported on the TEHSR Moscow-Rostov-Prokhladnoye-Darg-Kokh-Tbilisi-Persian Gulf of about 4000 kilometers, now with a real train speed of 300 km/h, time of travel on the prospective direction is 13.5 hours. If we take into account the down time even for 0.5 hours at each stop (in Russia – 3 stations, Georgia-Armenia-Iraq – 1 station, Iran and India – 2 stations), then for a slow passenger train we get 18.5 – this is more than 7 times faster, which is not a representable time saving. Goods trains can be passed in transit and without stopping. While this is hard to imagine, but time will show future passengers how they can travel from Moscow to the Persian Gulf by rail in less than a day.

Saving travel time is one of the main factors that attract a passenger and consignor to one or another mode of transport. The flattened direction of the future high-speed railway through the Greater Caucasus Mountain Range, which requires laying of a tunnel with a length of about 50–60 km, move the rail road from the mountainous category to the plain one (on the operational side). If according to the project of the Kavgiprotrans dated 1983, it was allowed to build tunnels with a length of about 42 km, 3 km of gallery, 11 km of sustainer walls and 76 bridges according to the Arkhotskiy variant, the total length of these constructional works on the flattened version from the station Darg-Kokh to Tbilisi is quite sufficient for construction a road by a tunnel and, thus, the road with dangerous operation conditions because of slopes goes over a safe one, omitting the great harm to the landscape and the Caucasus mountain ecosystems.

6. Future principal lines of the TEHSR and introducing a high-speed railway traffic

History of the development of the Russian railways takes the beginning from the construction of the direct railway line Petersburg-Moscow. Future TEHSR will meet the requirements of a flatted, and, if it is possible, shortest connection of the administrative-territorial center of Transcaucasia with the center of the North Caucasus with the further prolongation of the direct route to Moscow.

Such calculations and schemes were drawn up and sufficiently clearly shown in the project designs of Lengiprotrans dated 1945–1948. According to the proposed flattened scheme, the distance from Moscow to Darg-Koch through Michurinsk-Talovaya-Morozovskaya-Prokhladny is 1,532 km, and according to the current route through Rostov this distance is 1,947 km. From Darg-Koch to Tbilisi,
on a flattened line, the distance is 183 km, and through Baku it is 1,183 km. The table shows the distances from Moscow to Darg-Koch and Tbilisi by two actual and supposed flattened routes through the Greater Caucasus Mountain Range.

Table 3. of distances from Moscow to various destinations on the existing and future flattened lines

<table>
<thead>
<tr>
<th>Direction</th>
<th>Distance from Moscow to destination, km</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Darg-Koch</td>
</tr>
<tr>
<td>Through Rostov-on-Don – Beslan – Baku</td>
<td>1947</td>
</tr>
<tr>
<td>Through Tuapse</td>
<td>–</td>
</tr>
<tr>
<td>On the proposed flattened line through Michurinsk – Kalach-Morozovskaya-Blagodarnyy-Prokhladnyy</td>
<td>1532</td>
</tr>
</tbody>
</table>

The direction Moscow-Darg-Koch through Rostov-on-Don also provides an unnecessarily long transportation of cargo and passengers for more than 400 km. In general, the relatively flattened line from Moscow to Tbilisi through the TEHSR theoretically reduces the rail line by more than 1,400 km. However, at the first stage, the main emphasis should be made on removal the unnecessarily long transportation through the TEHSR, which is about 1000 km.

The existing railway network, lying north and south in the meridian direction, developed in the interests of connecting large settlements by overcoming the least resistance to barriers of natural geography and mining and geological character, without aiming for reduction the future unnecessarily long transportation of cargo and loss of passengers travel time. A similar trend was the result of the construction around the TEHSR of latitudinal long distance rail and motor traffic, which passed the meridian direction. Question of crossing the Alpine, Apennine and Carpathian mountains by transport corridors, even under the conditions of different states, was put at once, without any circular variants and directions.

Future fast and high-speed traffic sets today a problem of flattening the route in terms of and in the profile, bringing it to a straight line between the main cargo generating points. The TEHSR will be a transit high-speed railway segment between Russia and Transcaucasian countries, between Western Europe and Southeast Asia, and when solving this transport problem in the future, the average speed of 350 km/h will be perceived as normally perceiving today’s speed of 250 km/h in Western Europe, Japan and other world’s railways.
Last project of the TEHSR (Kavgiprotrans, 1977–1983) through the Arkhoti Pass, started by construction, and, after two years, stopped for national political reasons, did not meet the current and, even more, future requirements of interstate and intercontinental transport links. Today, it is possible to really discuss the issue of crossing a distance of 1,715 km Moscow-Tbilisi in 5 hours instead of two days now. For the North Caucasus, it is one hour less and depends on where the railway station of the future high-speed road will be located – in Kargin, Dzuarikau, or in Alagir.

According to the existing plan of exploratory studies, the search for an advantageous variant of crossing the TEHSR railroad came down to a search for better development of the canons by rivers and a narrow part of the range in order to cross it through a short tunnel.

Basis for the TEHSR project designs in the 80s of the 20th century is this trend, and statement of a question of preliminary economic considerations always led to confirmation of the solution of technical problem in the stated aspect. This was justified, since the average speed of the trains was 50–70 km per hour with the assumption of applying small radiuses of curves, maximum longitudinal slopes, multiple traction, etc. Nowadays, when the world’s railways focus on increasing in speed, saving time of the passengers travel and quick introduction of goods into the economic turnover, the old approaches and design standards are now fading into history. Regarding new requirements, the railroad must be maximally flattened, without specific rises and falls, be extremely safe, and in mountain conditions – protected from slopes.

Review of the scientific and technical literature on the TEHSR problem from the beginning of the idea to the present day, the desktop and field studies of projects and topographic maps, taking into account the modern development of global rail transport in the light of future high-speed movements lead to the conclusion that a high-speed railway through the TEHSR will pass along a flattened line from Darg-Kokh to Tbilisi with a length of 183 km and a tunnel of 57 km or with the shortest construction length of 108.6 km Alagir-Tskhinval and a tunnel of 40 km (Fig. 5).

Significance of the road in the future grows into an intercontinental transport corridor that serves the transport space of many countries in Europe and Asia. It will cover high-speed feeders of other neighboring states.
As noted above, in the area of the Caucasus uplands, the future road should be constructed in two directions of the flattened and shortest possible variants. It should be noted in advance that the operational features for the flattened variant better meet the TEHSR requirements.

Figure 5. Schematic of the proposed railway Darg-Kokh – Tbilisi
Flattened variant

The plan of route from the station Darg-Kokh turns on south against the stream of the river Fiagdon, lies along its left side to the settlement of Dzuarikau on an open flattened line. Behind the village, the canon gets narrow and the road is laid along the left bank above the highway, crossing marginal ravines and feeders by viaducts and bridges, and the slopes – by the shorter tunnels parallel to the river. The route comes to a narrow place below the village Nizhniy Fiagdon, where the northern portal of the tunnel is located. The tunnel with a length of 57 km crosses the western part of the Kazbek Mountain, the heads of the Terek and Belaya Aragva Rivers, the Lomissky pass with access to the southern portal in the head of Chysanydon River. Then, the road goes along the left slope of the river to the settlement of Ksani, adjoining the Transcaucasian railway.

The road cross section begin with a mark of 355 m at the station Darg-Kokh and the average slope of the terrain passes through the pre-mountain plain to the village of Dzuariukau with a slope of 14%. From Dzuarikau to the northern portal, the road rises by the middle slope of the river. The northern portal is located at a mark of 1152 m. The tunnel is proposed to construct with double-slope camber in the northern part of 16% and with a length of about 39 km, and in the southern part of 14% with a length of 18 km with a maximum point of 1,599 m under the floodplain of river Terek. That was supposed to build a mine or an inclined tunnel for the additional mine working, and during operation it can be used as ventilation structures. From the mark of 1,361 m of the southern portal down to the station Ksani of the Transcaucasian railway, there is an inclination of 18%, which is equal to the average fall of stream of the river Chysanydon (Fig. 6).

Figure 6. Schematically concise longitudinal profile of the flattened road on the Greater Caucasus Mountain Range section

For piercing of a long tunnel of 57 km, in the head of the Terek River near the Cob village, there is a possibility of an additional mining works.
Organizationally, all well-planned access roads are suitable for all proposed mining works. Power lines are nearby. On the southern slope of the section from the portal to village Leningor, the access road should be reconstructed, and the power lines should be laid at the same distance.

**Shortest way variant**

The shortest way in the construction relation is the shortest, but in the historical, economic and technical terms, it is sufficiently known, studied and researched. According to this variant, the Alagir station of the North-Caucasian Railway connects with the Tskhinval station of the Transcaucasian Railway and is referred to as the Gori direction of the TEHSR.

In 1932–1933, feeders from Darg-Kokh to Alagir with a length of 28 km (both in the north and in the south) were constructed in the sub-mountainous areas, and in 1939–1940, feeders from Gori to Tskhinvali with a length of 33 km were lied.

**The plan of route** starts from the existing Alagir station of the North Caucasian railway and lies along the motor road to the Tamisk resort. In the Tamisk region, with viaduct and bridge the route crosses the motor road the river Ardon, and then goes up against a stream of the river along the right slope opposite to the highway, up to 28.6 km near river Archon. It is planned to locate the northern portal of the tunnel, which passes through a rock massif of 39.5 km in the direction of the Southern Portal. Then it crosses the Greater Caucasus Mountain Range between the Roksky and Magsky rolls and comes to the surface of 68.1 km above the village Bagiata. Then, it goes to the village Gufta, crossing the Liakhva River and passing to its right bank. On this slope it lies to the terminal station of Tskhinval. The length of the road according to this variant is 108.6 km.

The **road cross section** starts with a rail mark of 535 m at the Alagir station and goes along the slope of the river Ardon. It is characterized by the following parameters. At the first 10 km – 15%, at the 10 km section and up to the northern portal – 16%. At 1.087 m, the northern portal will be located. The tunnel is provided with a single-slope tunnel with a slope of 10%. At the intersection of river Zakidon, there is a mine provided from the surface of the earth to the highest point of the tunnel, which in the process of construction will serve for additional mine working, and during operation it can be used as ventilation structures. From the southern portal of 68.1 km to the terminal station of Tskhinval, the slope varies within 17% and is equal to the slope of the river B. Liahva. The mark of the rail junction in Tskhinval is 880 m (see Fig. 7).
Operational features of the directions under consideration

Working length of the flattened road is 183 km that is its construction length between the stations of Darg-Kokh-Tbilisi. Working length of the Goriyskiy direction between these points is 243.6 km, including 108.6 km of new structures, and 135 km of the existing railway. Laying-out the northern point of the route junction to the existing road in the relief-territorial terms is not limited to anything. And, in the southern sector it is associated with difficulties, which it is necessary to make a comprehensive technical and economic analysis for.

During blossoming Soviet economy, the Tbilisi railroad junction was overloaded and even then a study aimed at its unloading was conducted. With the increase in cargo traffic in Georgia and in the regions of the Transcaucasian republics, the Tbilisi railroad junction is unlikely to be able to pass the Transcaucasian cargo traffic, especially the future high-speed transit transport. Hence, the best way is to bypass Tbilisi, east or west. If the direction from Tbilisi is oriented to the south – to Armenia and Turkey to the Marneuli station, then the eastern course towards Kakhetia extends the route and creates a lot of uncomfortable and complex transport and relief intersections. This was considered in the design and construction of the TEHSR in the 1980s and is called the Khevsursky variant. It was proposed with a view of Tbilisi’s transport unloading and development of new regions of Georgia. Construction length of the road is 222 km, and the working length along this route is almost 300 km. Due to the deviation of the course eastward from the flattened line, the route becomes inconvenient, especially for the future high-speed movement in the Armenian-Turkish direction and loses its competitiveness.
Figure 8. Schematic of the proposed high-speed railroad at the Darg-Kokh-Marneuli section
If we construct a road on the western route in Tbilisi, we need to excavate a tunnel from Digomi to Kumisi with a length of about 12 km with an open station in Digomi, or a closed tunnel variant in the Vake. If the location of the station is moving in the form of an open to the southwest, to the side of the existing stations of Marneuli and Ksani, the idea suggests itself that a new, more perfect than Khevsursky variant line from Ksani station to Marneuli station with a tunnel crossing of the Trialeti Range with a length of 33 km. This road would get away the inconvenience for Tbilisi, use the new transport direction of Georgia and better than the Khevsursky and Tbilisi routes, would ensure the conditions of rapid movement and reduce the distance to the South Asian direction i.e. approached the requirements for future transit high-speed line. At the same time, the working length in this direction is reduced in comparison with the way through Tbilisi and the road turns out shorter from the station of the Darg-Kokh of the North-Caucasian railway to the Marneuli station of the Transcaucasian railway (Fig. 8).

8. Significance and intersections of the TEHSR with the lines of the EU and Russia transport corridors

As noted above, in detail, for transportation of goods from the central part of the Russian Federation to the Persian Gulf, through the North-South transport corridor, the amount of time required is more than 5 days. Through the future TEHSR, the time for goods delivery conditionally from Moscow to Delhi will be the average of 15 hours, which reduces the travel time, up average, 8 times.

In addition to the North-South corridor, the TEHSR also crosses the TRACECA transport corridor, through which goods are transported from the EU countries to Central Asia, in the Russian part of Asia and the direction of the Far Eastern countries. At the same time, this scheme of cargo transportation is even worse than the North-South corridor. Through this transport corridor, cargo is reloaded from land transport modes to sea lanes at the sections of the Black and Caspian Seas.

There is no need to provide detailed calculations of the overly complex transportation of goods through the TRACECA transport corridor, since they are listed above for the North-South corridor for one-time transportation on the Caspian Sea Route. Here it is necessary to organize a double overload. Scheme for crossing the TEHSR considered as the original transport corridor crossing two Euro-Asian transport corridors is shown in (Figure 9).
9. Desired investments for introduction of TEHSR

The continued construction of the Transcaucasian railway in the beginning of the XX century in the southern direction to Turkey and the completion of a 270 km long section of the Sorykamysh-Erzurum-Mamakhatun road “created conditions for the construction of a transcontinental line from the Persian Gulf to Western Europe for the transportation of goods delivered by months by caravan tracks through the Transcaucasus” [4, P. 183].
Erstwhile, during the active discussions of the idea of the TEHSR in Western Europe and in America, at the initiative of N. V. Filkovitch to this direction, linking “Paris with Persia according to the Statkovsky’ project through the Mag- sky Pass” [21], has been attached international significance. Later, “in March 1903, N. V. Filkovich involves in decision-making processes Etienne, a Vice-President of the Chamber of Deputies (France). Germany was also interested in the road. It proposed joint efforts to construct a railway from France through Germany, Russia (Caucasus) to Baghdad”.

Propaganda of the TEHSR construction in Russia on account of the borrowed foreign private capital was on a grand scale, but was not supported by Russian Finance Minister, Reitern M. H. However, during the rise of railroad construction, he was an active supporter of the attraction of private capital to the railway construction in Russia. The Russian railroad has been developed not only with resources from the treasury, but financial assets of the “private societies and foreign loans”, increasing the inflow of foreign capital, were widely used. Russia paid to Western European campaigns huge amounts that reached 3 billion rubles” [1].

History tells us and gives the right direction to the future. High-speed traffic in Europe and in the world was not carried out everywhere with resources from the treasury of certain states, but also due to active assistance of private capital of joint-stock companies and other construction and commercial firms and banks. The large-scale construction of high-speed lines in the world at large is being carried out at the expense of raising funds from the International Development Bank, the Railways Development Fund, etc. The International Union of Railways and the European Investment Bank (EIB) are also involved in dissolving the problem of high-speed rail construction on the European continent. Europe has come to the point of declaring a continent without borders in cargo transportation. Since 1990, the European Investment Bank has provided loans for 15 billion euros for projects in the enlargement countries, where 7.2 billion euros were allocated for transport projects, mainly railways and highways link the enlargement countries to the EU network. From 1990 to 2001 EIB financed railway projects in the enlargement countries in the amounts equal to (million euros): Bulgaria – 890, Hungary – 250, Latvia – 34, Lithuania – 40, Poland – 460, Romania – 215, Slovakia – 200, Slovenia – 60, Czech Republic – 560 and Estonia – 16” [3].

We think, we should seriously consider the successful practice of the banking system and the entire railway community of foreign countries in the construction of high-speed railways and give the necessary impetus from the Russian side, which will allow to bring our transportation to a new technological and financial-profitable level. The railway community should make every effort
to approve the Russian priority introducing the TEHSR, so that not to miss the chance of gaining economic benefits for Russian society.

**Summary and Conclusions**

This monograph is a first step in solving of problem of the original Euro-Asian transport corridor – a unique Trans-Eurasian high-speed reinforced concrete structure designed to usher in peace and friendship between states and peoples. If that is so, then our appeal to you is:

Messieurs! – Wealthy people, Multi-millionaires, Bankers and Stock Holders of the States! (We write in big letters, because these are all signs of the mind and talent of the human and yours, in a given case).

1. A problem under consideration is an arduous, even theoretically. However, the idea is feasible with the bolder approach of a multi-millionaire or multi-millionnaires, who are expected to make huge profits if they invest their capital in this complex but desperately needed for the future development of neighboring countries against the unsuccessfully developing transport corridors between Europe and Asia.

2. We think that a complicate Caucasus section with five tunnels should be built by the joint forces of the countries concerned, the rest of the plain part should explore each country on its geographical area. With such a structural sophisticated approaches, solving the problem should involve the forces and capabilities of the United Nations Organizations and its Banner should be placed on the highest geographical point of the TEHSR.

3. The road should be constructed under the aegis of the United Nations should set up a special commission or committee to develop a unified approach for all interested states in Europe and Asia.

4. The authors of this monograph are ready for talks on technical, technological, economic, financial, organizational, political and other aspects.

5. Eyes of the initiators of construction should be directed to the United Nations Organizations, and their capital should be allocated to implement the original and unique construction of ALL THE AGES! The future great construction will be named after them!

*Please send your questions and comments on e-mail: lbtranskama@mail.ru.*
References

1. Газета «Фигаро». 6 января – 1898 г.
2. Гусалов Н.А., Кортнев Л.И. Транскавказская автомагистраль. Орджоникидзе, – 1987. – 120 с.
17. Статковский Г. И. Кратчайшее соединение Закавказья с Россией железным путем. – Тифлис, – 1878.
21. Филькович Н. В. Экономический очерк к проекту постройки Центрально-Кавказской железной дороги через Рокский или Магский перевалы Главного Кавказского хребта», СПб.: 25 февраля 1897 г. (в 1896 г. на французском в г. Льеже (Бельгия)).