Сравнительный анализ Эресуннского и Керченского мостов

Прохорчук Е.Д., студентка 4-ого курса финансового факультета РЭУ им. Г.В. Плеханова

Ревина Д.С., студентка 4-ого курса финансового факультета РЭУ им. Г.В. Плеханова

Трындина Н.С., студентка 4-ого курса финансового факультета РЭУ им. Г.В. Плеханова

Аннотация

В статье представлен анализ сходств и различий подходов к проектированию, строительству и обслуживанию мостов стратегического значения в России и Европейских странах на примере двух мостов, один из которых соединяет Швецию и Данию, а второй – Таманский полуостров и Крым. Основными отличиями Керченского моста являются условие бесплатного пользования и значительно более высокая себестоимость по сравнению с европейским аналогом. В итоге, на основании проведенного исследования, были сделаны выводы и сформулированы предложения.

Ключевые слова: мост, инвестиции, проект, строительство, эффективность, Керчь, Эресунн

The comparative analysis of the Oresund Bridge and the Kerch Bridge (Crimea)

Prokhorchuk E.D., student, Plekhanov Russian University of Economics

Revina D.S., student, Plekhanov Russian University of Economics

Tryndina N.S., student, Plekhanov Russian University of Economics

Annotation

The article provides the analysis of the differences and similarities in European and Russian approaches to construction and maintenance of roads of strategic importance on the example of two bridges construction connecting Sweden and Denmark, and Taman and Crimea in Russia. Russian project has shown significantly higher costs in comparison with the European project and its main peculiarity is the free of charge use. Based on the results of observations and calculations some assumptions and recommendations were made.

Keywords: bridge, investment, project, construction, efficiency, Kerch, Oresund.

In today's open world, transportation becomes more and more significant both in terms of time and costs. In other words, it does really matter how fast, easily and cheaply one can reach a needed destination. It may happen that some places lack the connection or the existing one is not sufficient to satisfy citizens' needs in terms of speed or capacity. This is what has happened after the year 2014 in Russia, when the issue of connecting Crimea with Russian mainland appeared on the background of the tense political situation and the interruptions in food, electricity and communication supply of the peninsula. In that case, Russian government has taken the responsibility of providing the way to solve the problem by building a bridge between Taman and Kerch.

In order to analyze the efficiency and optimality of such a decision, we have contemplated making a comparison with world's best practices and have chosen a bridge built between Sweden and Denmark. We have decided to make a comparative analysis of those bridges because they are equally crucial connection routes. Moreover, they are almost equal in length and contain both the highway and the railway. Therefore, it will be easier to compare costs.

Building long bridges to connect important areas of one country, different countries, to decrease the travelling time and therefore to improve the wealth of the society is a widely used practice. China is the international leader in bridge building. The most well-known (and the longest, according to Guiness, 2011) cross-land bridge in the world is Chinese Danyang–Kunshan Grand Bridge, which is the part of Beijing–Shanghai High-Speed Railway. Its total length is 164,800 m. The other four out of five longest bridges are also part of this high-speed railway and are situated in China. Surprisingly, it only took 4 years from 2008 to 2011 to build this bridge. The longest water bridge is the famous Hangzhou Bay Bridge, the total length of which reaches 35 673 m. It also has a resort with a hotel, restaurants and a viewpoint in the middle, that have attracted multiple tourists every year since the bridge was open in 2007.

As we may see, the bridges we are going to compare, the Oresund Bridge and the Kerch Bridge, are average in size compared to world longest ones, but are extremely important ways to connect vital parts separated by the sea.

The Oresund Bridge, also known as Öresundbron,is situated between Malmö in Sweden and the capital of Denmark, Copenhagen, going through Kastrup, the international airport of Copenhagen, making it closer and more convenient for the Western Sweden inhabitants than the airports of Stockholm. The main goal of construction of this route was to connect Scandinavia and the European mainland. [3] The way is approximately 16 km long and consists of three sections: a bridge, a tunnel, and an artificial island of Peberholm connecting them, whereas the bridge itself is only 7.845 km.

There are two levels of the bridge: the upper deck is the highway with four driving lanes, while the lower deck is used for the two-way track railroad. The construction process began in the year 1993 and took 7 years so that the inauguration took place on the 1st of July 2000.

The artificial island of Peberholm is 4 km long and was built from the soil dredged from the Oresund seabed in the process of tunnel construction and it supports the bridge piers and the tunnel. It also enables the connection between the two-level bridge and the one-level tunnel. This bridge is also a popular tourist destination not only because of being a vital route, but also because of being a picturesque way, especially on the intersection of the bridge and the tunnel.

The total construction cost is DKK 19,6 billion, which is equal to €2,6 billion. It was financed by the bonds issue. The responsible company is owned by the Danish and Swedish Kingdoms in equal parts providing the highest AAA credit rating according to Standard&Poors. [4] The bonds are repaid from the fees paid by the car owners travelling by this route. One-way ticket costs €50 without any discounts and can be paid in cash or by a credit card.

The Kerch Strait Bridge that is going to connect the Taman peninsula in the mainland of Russian Federation and Kerch, which is the area in Crimea, is not yet build, but the construction is already in process.

Building the Kerch Bridge is an important political decision. It is being built in order to accomplish the following strategic goals:

- have a direct and free of charge highway connection between the Russian mainland and the Republic of Crimea and the city with federal status Sevastopol;
- have a shorter faultless railway service;
- to increase the touristic attractiveness of the region;
- to boost domestic and foreign investment in both Crimea and Kuban regions;
- to ensure stable and efficient supply of goods to the peninsula.

The total length of the Kerch Bridge is expected to be 19 km, there are going to be four driving lanes for cars and a two-way track railway lines, making this bridge comparable to the Oresundbron. It is going to have an existing island Tuzla approximately in the middle for extra security and stability and for facilitation of the building process.

The construction work started in the year of 2015 and is expected to be finished soon so that the highway is going to be opened for the public by the end of 2018. The exact date is forecasted to be 18 of December 2018, while the railroad is expected to take a bit more time to be built, so it is promised to be opened in 2019 [3].

According to the plan mentioned on the bridge webpage, the bridge is being built simultaneously from 8 points. Moreover, it is situated in the seismic-free area and is build using the

tectonic-proof technology. The project engineering company PJSC “Institute Giprostroymost – St Petersburg”. Project management of the construction process is delegated to LLC “SGM-Most”, that was created especially for this purpose in 2015. Another point worth mentioning is that this bridge is going to be free of charge.

These all factors should we reflected when we are considering the cost of the construction, which is equal to RUR 227.92 billion (RUR 223.14 spent by the contractor LLC “StroyGazMontazh” on the basis of the order of the government of the Russian Federation, dated 30.01.2015 №118-R and RUR 4.78 by the contract-giver, which is the Federal State Institution “Management of Federal Highways ‘Taman’” of the Federal Road Agency of the Russian Federation on the basis of the order of the government of the Russian Federation, dated 30.01.2015 №118-R).

As we can see, those two bridges are very similar except for the fact that Russian engineers chose bridge over tunnel for the following reasons:

- problem of the storage of millions cubic meters of soil extracted from the bottom of the straight during the construction;
- danger of the building in the zone tectonic fault which may cause the fracture of the tunnel;
- with the projected carrying capacity of 40,000 vehicles and 94 trains daily it is required to build at least two tunnels for passengers and a service one, which would be used in emergency cases and during repairmen;
- oozy bottom, making the construction way more complex and besides twice as expensive.

We decided to make a thorough analysis on the basis of comparison of various efficiency, cost, and capacity indicators.

Table 1. Comparison of the main indicators of Oresund and Kerch bridges

Comparison	**Oresund**	**Kerch**
Total length, km	16	19
Total cost, € billion	2,6	3,27
Cost per 1 m, €	162 500	172 105
Time of construction, year	7	5
Road fee, €	50	0
Traffic flow, thousand vehicles daily	19	16
Railway Passenger flow, million people annually	7	15
Income per year, thousand €	346 750	0
Payback period, years	7	-

Source: composed by authors on the base of [1] and [5]

As we can see from Table 1 and the information stated above, the bridges are certainly similar. We have therefore compared them in accordance with several factors. For example, the Kerch Bridge connecting Crimea to the Russian mainland, is 3 km longer than the whole connecting route between Swedish and Danish land. Nonetheless, the Oresund bridge is not just a bridge, but a system of a tunnel, a man-made island of Peberholm, and a bridge itself, so it could have resulted in a substantial increase in costs.

Another factor that could add to the total costs was the fact that Russian construction engineers used the existing island Tuzla for additional support to poles, the Scandinavians had to build a new artificial island from the extracted soil. However, the total forecasted costs of the Kerch Bridge appeared to be higher, though it is difficult to give a precise figure because the bridge is not yet completed, and due to the fluctuations in Russian national currency, ruble, against Euro.

After this, the costs per 1 meter of bridge were calculated and it turned out that Kerch Bridge is slightly more expensive than the Oresundbron. The traffic analysis carried out afterwards shows that the railway passenger flow of the Kerch Bridge is expected to outperform the Oresund one more than twofold, whilst the vehicle flow through the former is projected to be almost 16% lower than through the latter.

Then we moved to the financial aspect of the bridge building. As we have mentioned earlier, one should pay for his or her way through the Oresundbron, so that the responsible company owned by Swedish and Danish governments receives the revenues, which enable it not only to cover the costs, but also pay for bridge, tunnel, road, and railway maintenance. [5] Assuming 365 days in a year and yearly estimated car flow, and the fee totaling 50 Euros, it can be concluded that the average annual revenue should be around 346.8 million Euros, not taking into consideration the inflation, the project paid off already in the year 2008. This assumption can be also proved by the calculation of the payback period that should have been approximately 7 years.

On the contrast, in the Russian case, the construction of the bridge is of strategic and socio-economic importance for the region, thus it is free of charge. Furthermore, the project was initiated by the Russian governments order and therefore was financed from the federal budget. [2] It can be seen both as an advantage and disadvantage of the Kerch bridge. On the one hand, it seems fair and just that the bridge financed with the money of the taxpayers and every citizen can reach Crimea for free. On the other hand, Russia is an enormous country, hence relatively small portion of the citizens will be using the bridge and it might be unfair for the majority to pay for the needs of others.

However, the possible considerations behind this financing decision could be as follows: Crimea region is expected to become one of the most attractive touristic destinations for many

Russians. Thus, in order to make it easier to reach and less expensive to afford, the Kerch bridge would truly benefit not only to those, who live nearby but also to all those people, who would choose Crimea as a resort. This, in turn, could result in increasing cash inflows to the region and would a number of socio-economic indexes, which would reflect the level of development of the whole region. So, building the Kerch bridge with the use of budget as the financing source can be justified by two main factors: Russians having a new affordable and reachable resort and socio-economic development of the region itself.

Table 2. Efficiency indicators of the bridges, compared to alternative means of transport

	Oresund	**Kerch**
Ferry fee, 1 car + 2 people, €	36	29
Bridge fee, €	50	0
Travel time, no bridge	97	129
Travel time, bridge	35	47

Source: composed by authors on the base of [1] and [5]

Another aspect that should be taken into consideration when analyzing the efficiency and usefulness of both bridges is the benefit of the passengers travelling though the bridge. Obviously, in both cases there are alternative ways of connecting the two cities, namely the ferry boat. Therefore, we compared the travelling routes using the bridge and the ferry in terms of the price and time being consumed.

The results show that in case of the Oresund, the ferry fees are 14 Euros less expensive but it takes almost thrice as much time to travel, consequently it is up to consumers to decide what is more important for them minimizing costs or saving time. However, talking about the bridge in the Kerch straight, the users will benefit both in terms of time spent to reach the Crimea peninsula (2.7 times faster) and would not have to pay anything.

As can be seen from the research we have run, the Kerch bridge is comparable to one built more than a decade ago between Sweden and Denmark. We have analyzed them both in terms of source of financing, total costs, associated with engineering and construction, cost per one meter, the choice of technology, capacity, expected car flow and calculated the efficiency indicators.

The Russian bridge turned to be more expensive with lower car traffic and both capacity and time of construction being just forecasted. On the other hand, the Kerch bridge will serve higher railway passengers flow, its use will be free of charge for car owners and its construction is more complicated due to natural geographical peculiarities of the region. Overall, both of the bridges are of high importance for the territories they have been constructed on and help or will help to reach strategic and tactical goals their construction has been contemplated for. Anyway, it will take time to

see how the Russian bridge will operate and then more profound comparative analysis between two bridges will be possible.

Список использованных источников

1. Крымский мост. (n.d.). О проекте [Электронный ресурс] – Режим доступа. - http://www.most.life/o-proekte/ (дата обращения 06.02.2018).

2. Стоянова Я.Я., Цопа Н.В. Финансово–экономические особенности инвестирования в строительство моста через Керченский пролив // Инновационное развитие строительства и архитектуры: взгляд в будущее. – 2017. – С. 205-207.

3. Hospers G. J. Borders, bridges and branding: The transformation of the Øresund region into an imagined space //European Planning Studies, 2006, T. 14, No. 8, pp. 1015-1033.

4. Oresundsbron.com. (n.d.). Øresundsbron FINANCE [Электронный ресурс] – Режим доступа. - https://www.oresundsbron.com/en/info/finance (дата обращения 06.02.2018).

5. Peeters B. et al. Continuous monitoring of the Øresund Bridge: system and data analysis // Structures and Infrastructure Engineering, 2009, T. 5, No. 5, pp. 395-405.

References

1. Krymskij most. (n.d.). O proekte. [online] http://www.most.life/o-proekte/

2. Stojanova Ja.Ja., Copa N.V. Finansovo–jekonomicheskie osobennosti investirovanija v stroitel'stvo mosta cherez Kerchenskij proliv // Innovacionnoe razvitie stroitel'stva i arhitektury: vzgljad v budushhee, 2017, pp. 205-207.

3. Hospers G. J. Borders, bridges and branding: The transformation of the Øresund region into an imagined space //European Planning Studies, 2006, T. 14, No. 8, pp. 1015-1033.

4. Oresundsbron.com. (n.d.). Øresundsbron FINANCE https://www.oresundsbron.com/en/info/finance

5. Peeters B. et al. Continuous monitoring of the Øresund Bridge: system and data analysis // Structures and Infrastructure Engineering, 2009, T. 5, No. 5, pp. 395-405.