

**FEASIBILITY STUDY BASED ON MULTI-CRITERIA ANALYSIS FOR LOCATION
OF THIRD BRIDGE ACROSS THE DANUBE RIVER BETWEEN ROMANIA AND
BULGARIA**

Alexander Jiponov¹

Assistant Professor in department of “Roads and Transport Structural Facilities”, Faculty of
Transportation Engineering, UACEG, Sofia, Bulgaria

Abstract

A comparative study based on a multi-criteria analysis is prepared for the selection of the optimal site location.

Multi-criteria analysis tries to capture and compare the long-term influence of the execution of the bridge across the Danube river (in each of the four sites), as a component of the SA – ST system (system of social and economic activities - transport), the change is considered major (producing significant changes in the system equilibrium).

The sites proposed by the beneficiary for the analysis: CĂLĂRAȘI – SILISTRA; GIURGIU – RUSE; TURNU MAGURELE – NICOPOL; BECHET – ORYAHOVO.

A multi-criteria analysis concerning a series of aspects is conducted for all the four sites.

The analysis aims to improve the territorial accessibility, objective also included in the “Operational Program of Transboundary Cooperation Romania-Bulgaria”.

Abstract:

Multicriteria analysis, Danube bridge crossing

1. NECESSITY AND EXPEDIENCY OF THE INVESTMENT

1.1 Necessity of the investment

Danube river is the second largest European river, both in length (2.857 km) and in flow (approximately 5,600 m/s when it enters Romania), and it is also a part of the Pan-European transport corridor №7.

Danube river is an important waterway, which through the Rhine-Main-Danube canal realizes the connection between port Constanta, the industrial centers in Western Europe and port Rotterdam.

For both Romania and Bulgaria Danube river represents an under-exploited potential for development and economic growth. Considering the use of this potential an important role is the improvement of the connectivity between the two countries via realizing of constant river crossings.

The points for crossing the Danube river between Romania and Bulgaria are: Ruse – Giurgiu (road and railway bridge), Vidin – Calafat (road and railway bridge), Oryahovo – Bechet (ferryboat), Nikopol – Turnu Magurele, Svishtov – Zimnicea (ferryboat), Silistra – Calarasi (ferryboat).

¹ Alexander Jiponov, D-r Eng., Sofia, Bulgaria, ajiponov@gmail.com

From all 650km on which Danube is a border between Romania and other Danube countries, 470 km are border with Bulgaria, and the cross-border cooperation between the coupled cities along the river banks of Danube: Vidin – Calafat, Nikopol – Turnu Magurele, Svishtov – Zimnicea, Ruse – Giurgiu, Tutrakan – Oltenita and Silistra – Calarasi is an important factor for the overall development of the region.

After construction of the bridge Vidin – Calafat along the Danube sector between km 796+000 and km 488+700 (Ruse – Giurgiu), there is not a single constant crossing of the river.

Tab. 1 Distribution of Danube bridges:

Country	No. of bridges	Length of river section, [km]	Distance between two bridges, [km]
Germany	34	161	5
Austria	5	67	13
Slovakia	33	362	11
Hungary	15	326	22
Serbia	14	685	49
Romania	7	1045	149
Bulgaria	2	300	300

Within the Inter-ministerial committee of sustainable development of the inland waterway transport in the common section of Danube (created 2012) an action plan regarding realization of common goals have been approved.

The action plan of the Inter-ministerial committee provides for a detail study on the construction of a third bridge over the Danube, an action which endorses improving of the connectivity between Romania and Bulgaria – within the strategic project “Strategic Project for Sustainable Territorial Development of the cross-border area Romania-Bulgaria” (SPATIAL).

1.2 Expediency of the investment

Ministry of Regional Development and Public Administration implemented the strategic project “Common Strategy for Sustainable Territorial Development of the cross-border area Romania-Bulgaria”, financed by the Program for European territorial cooperation Romania-Bulgaria. Within the project, one of the subjects studied relates to the projects for transport infrastructure for ensuring the connectivity and the territorial cohesion of the cross-border area. In this context, it is necessary to analyse the alternatives for the location of a new bridge over the Danube at the Romanian-Bulgarian border.

The project contributes for identifying and prioritizing high impact actions for the cross-border area in the context of European Union development and the priorities promoted.

The administrative territories analysed in the project:

–7 Romanian regions: Mehedinti, Dolj, Olt, Teleorman, Giurgiu, Calarasi, Constanta;

–9 Bulgarian regions: Vidin, Vratsa, Montana, Pleven, Veliko Tarnovo, Ruse, Silistra, Dobrich and Razgrad.

The aim of the SPATIAL project is the harmonization of the whole area, which to lead to growing of the territorial, economic and social cohesion and economic competitiveness.

The development of the cross-border area in short, middle and long term is presented by a territorial strategy, which identifies specific objectives, programs, policies and actions in the sectors of economy, social sphere, culture, environment, infrastructure.

The main role of this project is to justify public policy options with an impact on the cross-border area and the priority of investments from public funds.

Ministry of Regional Development and Public Administration (of Romania) (MRDAP) as a coordinator (lead partner) of the project “Common Strategy for Sustainable Territorial Development of the cross-border area Romania-Bulgaria” has opened a procedure for developing a feasibility study for the purpose of the investment – Construction of third bridge over Danube river between Romania and Bulgaria.

The overall objective of the contract is to contribute to the implementation of the pilot project in the field of transport –improving the cohesion in the cross-border area Romania - Bulgaria.

The feasibility study for construction of third bridge over Danube river in the cross-border area Romania-Bulgaria, substantiates the need and appropriateness of this investment objective based on economic and technical data. The conclusions of the studies will be proposed for analysis to both Romanian and Bulgarian Governments, considering the decision on the appropriateness of constructing a third bridge over Danube river in the cross-border area Romania-Bulgaria. Also, the prescriptions of “Law №10/1995” regarding the quality of the construction works have been complied with.

2. TECHNICAL AND ECONOMIC SOLUTIONS PRESENTED IN THE STUDY

Within the project “Common Strategy for Sustainable Territorial Development of the cross-border area Romania-Bulgaria” the Ministry of Regional Development and Public Administration (of Romania) chose SC Transproiect 2001 SA (Romania) and EKJ Bulgaria Ltd (Bulgaria) for developing a feasibility study regarding the investment objective “Construction of third bridge over Danube river between Romania and Bulgaria”.

Within the documentation, which represents the feasibility study, a comparative study was developed, which is based on multi-criteria analysis of the locations.

The multi-criteria analysis aims to identify and compare the long-term impact of the Danube Bridge construction (in every of the four locations) as a component of the SA-ST system (system of economic and social actions – transport) and it is considered that the change is big (produces significant changes in the balance of system).

The analyzed location are as follows: SILISTRA - CALARASI; RUSE – GIURGIU; NIKOPOL – TURNU MAGURELE; ORYAHOVO – BECHET.

The analysis seeks to improve territorial access, a purpose contained also in the “Operational Program for Cross-Border Cooperation Romania – Bulgaria”.

Elaboration of the documents has been carried out in two stages.

During the First stage two or three route options were explored for each location.

The criteria (Criteria – C) based on which optimal option was chosen are: C1. Investment cost; C2. Technical parameters; C3. Connection to regional and European transport networks; C4. Economic and social impact; C5. Environmental impact.

Scoring by the criteria cost (C1), technical parameters (C2) and environmental impact (C5) are presented in specific tables. Scoring of criterium C3 was evaluated depending on the connection of the variants to the road networks on each coast. Social impact (C4) was evaluated as equal for all compared location options and 5 point were awarded in every one of the cases – very big impact.

During the Second stage the choice of the optimal location was examined.

The criteria based on which optimal location was chosen were the same as the ones which were used for the choice of optimal option, with the coefficients of significance differing between the two types.

If the price criterium (C1) was the most important factor in the first stage (optimal option), in the second stage (optimal location) it had little significance. The biggest significance in stage two has the social impact (C4).

Preliminary variant for the bridge

In all analysed variants, the Danube river is crossed by a bridge consisting of main structure and approaches (viaducts). The approaches and designed overpasses would have cross section according to the high-speed road with two lanes in each direction. Considering the length of the central span the suggested structural solution is cable-stayed bridge. The main structure, for all variants is cable-stayed with steel superstructure, reinforced concrete H-shaped pylons founded on reinforced concrete piles. The central span is chosen to maintain the gauge for ships, measured from the Danube river level for a flow rate with a 1% probability of exceeding.

Possible variants were compared and subjected to multicriteria analysis in order to select the optimal location.

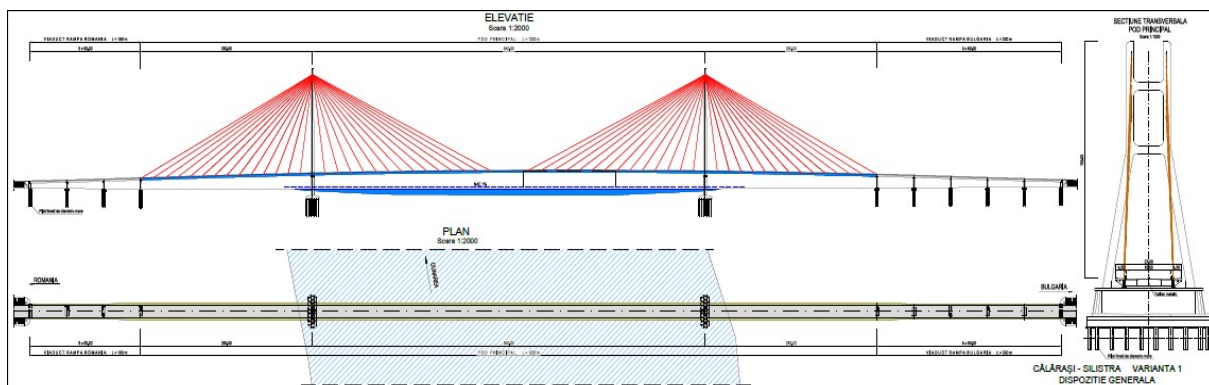


Fig. 1 General view of the bridge variants

SILISTRA – CALARASI – Bridge with length of $L = 280+640+280=1200\text{m}$, cable-stayed with steel superstructure, reinforced concrete H-shaped pylons founded on reinforced concrete piles. The approaches are with length $L = 3 \times 60 = 180\text{ m}$ on the Romanian coast and $L = 5 \times 60 = 300\text{ m}$ on the Bulgarian coast.

RUSE – GIURGIU – Bridge with length of $L = 320+740+320=1380\text{m}$, cable-stayed with steel superstructure, reinforced concrete H-shaped pylons founded on reinforced concrete piles. The approaches are with length $L = 10 \times 67 = 670\text{ m}$ on the Romanian coast and $L = 5 \times 67 = 335\text{ m}$ on the Bulgarian coast.

NIKOPOL – TURNU MAGURELE – Bridge with length of $L = 200+450+200=850\text{m}$, cable-stayed with steel superstructure, reinforced concrete H-shaped pylons founded on reinforced concrete piles. The viaducts for approaches are with length $L = 12 \times 60 = 720\text{ m}$ on the Romanian coast and $L = 8 \times 60 = 480\text{ m}$ on the Bulgarian coast.

ORYAHOVO – BECHET – Bridge is designed with length of $L = 200+450+200=850\text{m}$, cable-stayed with steel superstructure, reinforced concrete H-shaped pylons founded on reinforced concrete piles. The viaducts for approaches are with length $L = 15 \times 60 = 900\text{ m}$ on the Romanian coast and $L = 10 \times 60 = 600\text{ m}$ on the Bulgarian coast.

3. CONCLUSION

The degree of development of counties / regions within the surveyed locations, the close scoring values resulting from the analysis, materials and documentation submitted by local and central authorities show that construction of a bridge over the Danube river is appropriate and necessary (for the benefit of the communities on both sides) at locations “NIKOPOL – TURNU MAGURELE” and “SILISTRA – CALARASI”.

Based on the analyses performed within the current feasibility study, the priorities for “CONSTRUCTION OF THIRD BRIDGE OVER DANUBE RIVER BETWEEN ROMANIA AND BULGARIA” will be defined through a bilateral political decision.

References

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