GEOLOGICAL CONDITIONS FOR THE CONSTRUCTION OF THE RIVER SPREČA'S BASIN REGULATION ON D. DOBOŠNICA-MIRIČINE

Mevlida Operta
Faculty of Natural History, Sarajevo, Department of geography
Zmaja od Bosne 33-35, Sarajevo, Bosna i Hercegovina
Energo-engeenering, Sarajevo
opertamevlida@yahoo.com
Suada Pamuk
Energoinženjering, Sarajevo
suada.pamuk@energoinvest.ba

Spreča's depression belongs to neo-tectonic area of the Pannonian Basin, which was predisposed to Neotectonic movements of Alpine orogenisis. Morphologically and geo-tectonically complex area has arisen from differences of complex endogenic dynamics and geomorphologic processes. It is filled with Miocene and Pliocene-Quaternary sediments. On the north and northeast, depression is divided from Semberia and low Posavina by mountain horsts of Trebava and Majevica. On the southwest, the depression is divided from valleys of the rivers of Bosna, Krivaja and Drinjača, by eroded mountain cliffs of Ozren, Konjuh and Javornik, and on the very east part, it is divided from the Drina Valley by fold and hill Snagovo in which the Spreča's source is situated.

The Spreča's bed in length of approximately 8.5 km on direction Donja Dobošnica-Miričina is unordered and its riversides are devastated and overgrown with very frequent meandering and devastation of coastal parts and frequent transgression as well. The whole observed trace is situated in Quaternary sediments made of sand, gravel, clay, sand clay and clayish gravel. Such sediments are subjected to processes of erosion, transport, devastation and meandering of the river's flow. In order to stop frequent transgression of the valley in which cultivated areas are situated and to prevent from further bed's devastation, the Spreča River's flow regulation has been estimated in the mentioned trace.

In this paper geological-tectonic structure has been elaborated in detail, then hydro-geological and engineering geological characteristics of the terrain in direction of Donja Dobošnica-Miričina. Detailed geologic map and characteristic profile has been done for the observed terrain.

Key words: *Spreča River, bed, regulation, devastation, geological-tectonic structure, hydrogeology, engineering geological characteristics of the terrain*

INTRODUCTION

Spreča's depression has arisen from differences of complex endogenic dynamics and geomorphologic processes. Tectonic processes were especially intensified in modelling of relief since Eocene to nowadays. The depression originated along deep cut of the Spreča's fault in spreading direction NW-SE. The faults had been continuously extended and thus predisposed its descent and deepening during Tertiary. The central part of depression is part of Lukavac where depression is the most descended and where all three secondary depressions are connected (upper Spreča, Tuzla ravine and lower Spreča) in which, by decreasing the water level fluvial erosion increased, and by lake suppression the river system of today's

Spreča has been developed. In certain periods, Spreča ravine's sinking was faster from Spreča's bed incising into serpentine's barrier close to today's Modrac dam. As consequence of Neogenic geotectonic processes arisen important deposits of mineral raw and appearances of thermo-mineral and mineral waters of Toplice, Kiseljak, Sočkovac, and so.

Spreča's bed regulation on length 8,5 km in trace of Donja Dobošnica-Miričina has been accessed because the bed in that direction is unordered and slides devastated and overgrown with very frequent meandering and devastation of riverside's parts and frequent overflow. That is why in this move certain activities have been provided on regulation of the Spreča River, so in this paper were analysed geological-tectonic structure as well as hydro-geological and engineering geological characteristics in the space of future regulation.

GEOLOGICAL-TECTONIC STRUCTURE OF THE TERRAIN

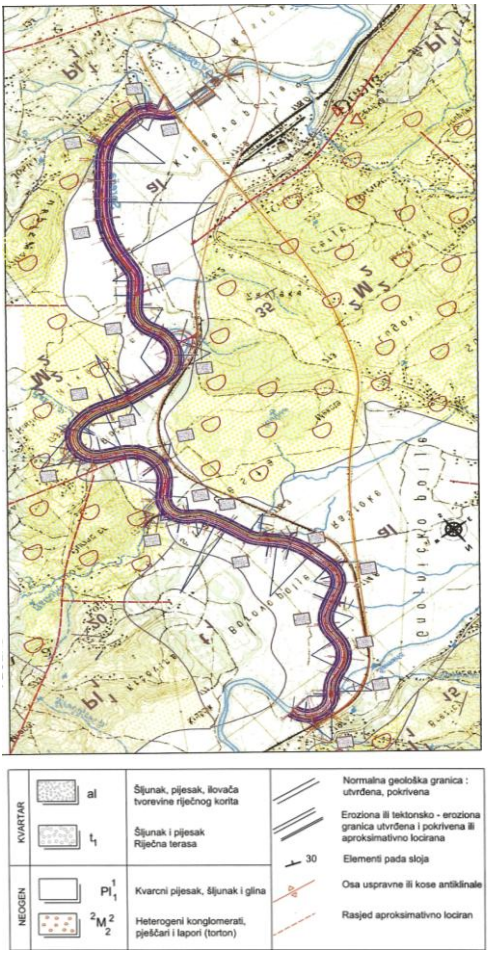

Figure 1. Geological map

In geological structure of south and southwest rim of Spreča's depression are dominated Palaeozoic ultrabasic rocks isolated as Krivaja-Konjuh and Ozren ophiolit complex which are in direct contact to sediments of the Spreča Tertiary complex. Palaeozoic and Mesozoic products represent basis on which Spreča's Paleozoic depression has been developed.

The River Spreča flows through wide valley with broad fields which are partially cultivated and planted with agriculture crops. River bed and riversides are quite devastated and unregulated. In the geological structure of the terrain on direction of Donja Dobošnica-Miričina participates sediments of Neogene and Quaternary (figure 1 and figure 2).

Neogenic sediments have wide distribution and are presented by Marine development. They are made of sediments of middle Miocene ($^2M_2^2$); heterogenic conglomerates, sandstones and torton marls as well as sediments of lower Pliocene (Pl_1^1) which are consist of quartz sand, gravel and clay. These sediments build wider hinterland of valley sides of the Spreča River.

Quaternary sediments mostly are developed in area of wider river valleys and along larger river flows such are Spreča and its tributaries. These sediments are isolated in form of river terrace (t_1), alluvial deposits in facia of river bed (al).

River terraces (t_1) are made of various shapes of gravel and level of roundness and sand. Gravel is of heterogenic composition where sandstone cobbles and motley chert prevail. This terrace is isolated on the left side in the region of Panjić and Kruševlje.

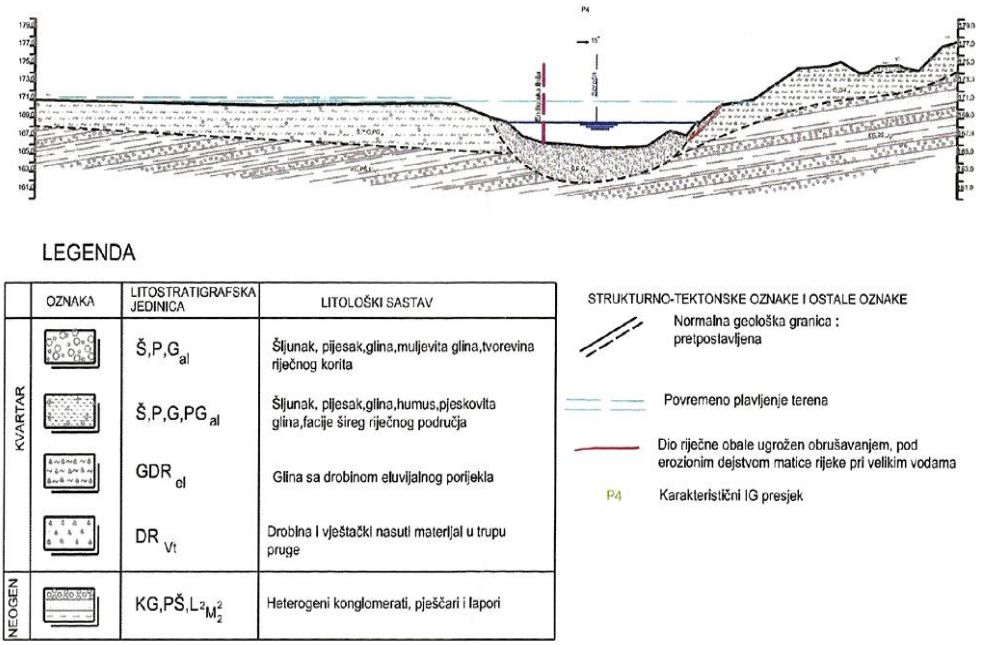

Figure 2. Tipical engineering profile

HYDROGEOLOGIC CHARACTERISTICS OF THE TERRAIN AND ROCK MASSES

Hydrogeological characteristics of wider area of Spreča field regarding the observed terrain are complex concerning hydrogeologic relationships which rule in hinterland and in central part of the field. Those relationships depend on lithological composition, hypsometric position of certain rock masses and on permeability of rocks which build observed terrain.

The River Spreča Basin area is situated in the terrain of complex geological structure. The basin's border was established orographically and amounts 1567.29 km^2 until the next regulation. Total regulated area amounts 50.94 km^2. The mean flow on water measure station Karanovac amounts Qsr= 23.1 m^3/s. Treated area of the Spreča River lies between mountain Ozren and slopes of mountain Majevica, so it represents complex geologic area built by rocks of various hydrogeologic functions and characteristics.

Permeable to poorly permeable rock masses are made of sediments of lower Pliocene. They are characterized by inter-granular porosity in gravel and sand zones, and tight ones in parts of clay layers.

Slight permeable to practically impermeable rock masses are presented by sediments of middle Miocene-conglomerates, sandstones and marls. In hydrogeological sense they have function of floor barrier with a function of hydrogeological isolator. Mainly they build the greatest part of the observed flow.

Very permeable rock masses are presented by sediments of the river's bed – gravel, sand, sandy gravel, clayish gravel. In wider alluvial plateau depending on presence of clay materials, this area is built by permeable to poorly permeable rocks.

ENGINEERING GEOLOGICAL CONDITIONS FOR BUILDING OF BASIN REGULATION

In order to stop frequent transgression of the valley on which are cultivated areas and to prevent from further devastation of basin, it was approached to drafting of project documentation with aim to regulate the flow of the Spreča River. Regulation of the Spreča has already been carried out from direction of Lukavac and it comes to existing bridge on the regional way Tuzla-Doboj. As in this part of abandoned and changed flow of the River Spreča, a binding channel, situated at the mouth of Kruševačka rijeka with bank cca 700 m in length has been carried out, there it comes to slowing down and yet to transgression of the settlement of D. Dobošnica. The whole observed route is situated in Quaternary sediments represented by sand, gravel, clay, sandy clay and clayish gravel. Such sediments are subjected to processes of erosion, transport and devastation as well as meandering of the river flow. Natural slope incline in materials of terrace gravels move in diapason of $25\text{-}60^0$, and most often $35\text{-}40^0$.

Gravel and sand in **the basin's facia** are found in the frame of modern basins of river flows. Physical-mechanical characteristics are very changeable when saturated with water. Capacity is decreased. There is possibility for greater settlings and deformations at seismic quakes. All that demand for special building regime and construction foundations. According to literature and experienced parameters for these regions, the following parameters are given:

- Volumetric weight $\gamma_z = 19.33$ kN/m^3
- Specific weight $\gamma_s = 28.40$ kN/m^3
- Porosity n=0.37%
- Porosity coefficient e=0.56%
- Inside friction angle $\varphi = 19^0$
- Cohesion c=0
- Natural humidity W=16.60%
- Plasticity limit Wp=38.40%
- Flow limit Wt=13.10%
- Plasticity index Ip=15.30
- Consistency index Ik=1.62
- Compression module Ms=5.44 MPa
- Dynamic elasticity module Ed=100 MPa

As the river regulation is on, excavations in river bed, according to GN 200 will be carried out in the II and the III categories in proportion 50%:50%. These excavations will be performed mainly in water so the slope and bed banks must be adapted to these conditions.

Gravel and sand of ***accumulation terraces*** participate in building of terrace-accumulation plateaus. In the surface part they are covered with clay-sand coverings. Gravels are of changeable granulation and petrographical composition. There dominate

hard-grained to middle grain varieties which are characterized by well capacity, poor compression and settling. Accession of microseismic intensity is possible, due to presence of underground waters to 1^0 MCS. Most probably in such environment defence bank will be built, as well as basin's regulation. Here are given the following physical-mechanical parameters:

Materials in coastal part of the river can be used as well for building the future bank. When using this material, it is necessary to clean from vegetation and humus covering in order to prevent from decay and with that, from bank settling. In such materials, excavations will be done according to GN 200 in the II and the III category in proportion 50%:50%.

- Volumetric weight γ_z=20.06 kN/m^3
- Specific weight γ_s=27.60 kN/m^3
- Poroznost n=0.4%
- Porosity coefficient e=0.66%
- Inside friction angle $\varphi = 24^0$
- Cohesion c=0.12 kp/cm^2
- Natural humidity W=23.91%
- Plasticity limit Wp=24.60%
- Flow limit Wt=34.80%
- Plasticity index Ip=10.20
- Consistency index Ik=1.10
- Compression module Ms=3.98 MPa
- Dynamic elasticity module Ed=75.9 MPa

Materials in coastal part of the river can be used as well for building the future bank. When using this material, it is necessary to clean from vegetation and humus covering in order to prevent from decay and with that, from bank settling. In such materials, excavations will be done according to GN 200 in the II and the III category in proportion 50%:50%.

CONCLUSION

Catchment area of the River Spreča lies in terrain with complex geological structure. The basin's border is defined orographically and it amounts 1567.29 km^2 until the end of future regulation. The middle flow on watermeter station Karanovac amounts Qsr= 23.1 m^3/s. In purpose of the Spreča regulation, observed was a part of terrain from D. Dubošnice to Miričine. Geological structure of the terrain is made of neogenic sediments ($^2M_2^2$ and Pl_1^1) and Quaternary sediments.

In a river flow zone, from engineering geological aspect, future regulations have equal building conditions. In this route zone, greater devastations can be seen in the very bed as well as transgression of the valley sides.

Excavations in zone of objects will be performed in rocks with changeable geo-mechanical characteristics and according to GN 200 those are the II and the III categories for river drifts and coverings.

Engineering geological characteristics of rock masses make complex of bound slight stoned, half-bound to unbound rock masses.

Explored terrain lies in a zone with stated quakes which intensity was 7^0 MCS for return period of 500 years. Having in mind accession of seismicity for calculations of objects, one should take the value of 8^0 MCS.

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Autors

Mevlida Operta was born in Tuzla, where she went to school. She graduated in Geology at the Faculty of Mining and Geology and also obtained master and PhD degree at the same university. Today, she is an Associate Professor at the Faculty of Sciences in Sarajevo. At the center of her scientific work are geological and mineralogical-petrographic studies. She has published over 80 scientific papers. Most of them represent original research papers, and some have an international review. She is author of four university textbooks. She has participated in the development of projects and studies in the field of geology.

Suada Pamuk was born in Pjevlja. She has studied and graduated in geology at the Faculty of Mining and Geology in Tuzla. Today, she works in Energoinvest in Sarajevo as lead designer. She participates in the preparation of project technical documentation in the field of geology, hydrogeology and engineering geology related to the regulation of riverbeds, rehabilitation, water supply and design of HPPs and SHPPs. She has participated in 13 projects as an associate. She is author of 17 projects related to the preparation of Studies, Preliminary Designs and Projects of Research Works. She has published 12 professional papers and some have an international review.