

Hydrogeological conditions of building the motorways in the area of Neogene basins in Central Serbia

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Abstract: This paper is revealing the categorization of Neogene basins in Central Serbia in accordance with the hydrogeological risk of construction and operation.

Key words: hydrogeology, roads, Neogene, categorization, basins, conditions of construction

INTRODUCTION

On the territory of Central Serbia (without the provinces), some 30 % of terrains are made of sediments from Neogene basins. In the geologic structure, down to the depths relevant for the motorway construction and operation, most frequently 5 - 10 m, rarely 10 - 20 m, the chronostratigraphic units from Pliocene to Helvetian take share, being represented by non-cohesive and semi-cohesive clastic materials (sands, seldom with gravels, silts, marls, clays). Within the local basins there are occurrences of coal deposits, then cohesive clastic materials (sandstones, seldom with conglomerates), and limestones. Through intense tectonic motions, these sediments are unevenly folded and in faults, out of which many are still active nowadays, and moreover subdivided into blocks. The rivers Sava and Danube, which represent the northern boundary of Central Serbia, created their own right valley banks prevailing within the Neogene beds. All right side tributaries of rivers Sava and Danube (Kolubara, V. Morava, Mlava, Pek, Timok) are almost entirely located on the Neogene basins wherein, during the Quaternary, the aforementioned rivers created their own valleys. With such a geologic structure of Neogene basins one may expect to find complex hydrogeological features of these terrains. Within the rock masses of these terrains there are all types of ground waters: physically and chemically linked, capillary and free gravitational which to a certain extent exert an impact onto the geotechnical properties of rock masses and terrains. Within the framework of water-bearing formations in Neogene deposits, numerous ground water storages were formed of differing characteristics as regards the spread and hydraulic mechanism, and thus exerting various influences on the motorway construction and operation.

Based on previous experience, the hydrogeological conditions of motorway construction and operation can be qualitatively defined for single basins. In this connection, this paper is revealing as to how the categorization of Neogene basins of Central Serbia has been carried out in accordance with that parameter.

1. CATEGORIZATION OF NEOGENE BASINS ACCORDING TO HYDROGEOLOGICAL CONDITIONS OF THE ROAD CONSTRUCTION

The morphology of Neogene terrains featuring wide, elongated and slightly rippled valleys and hilly slopes, in the past and nowadays provided for the most favorable conditions for the road planning and construction in Central Serbia. However, in practice and even in the up-to-date design, most frequently, due to the insufficient knowledge of hydrogeological properties of these terrains, we have encountered numerous problems, such as the endangering and protection of existing and planned sources for water-supply of population and economy, in addition to the disturbance or worsening of the terrain natural stability. In the wider perspective one may assert that the road network of Central Serbia has been formed along the three basic hydrogeological entities of higher rank (Fig. 1) as follows:

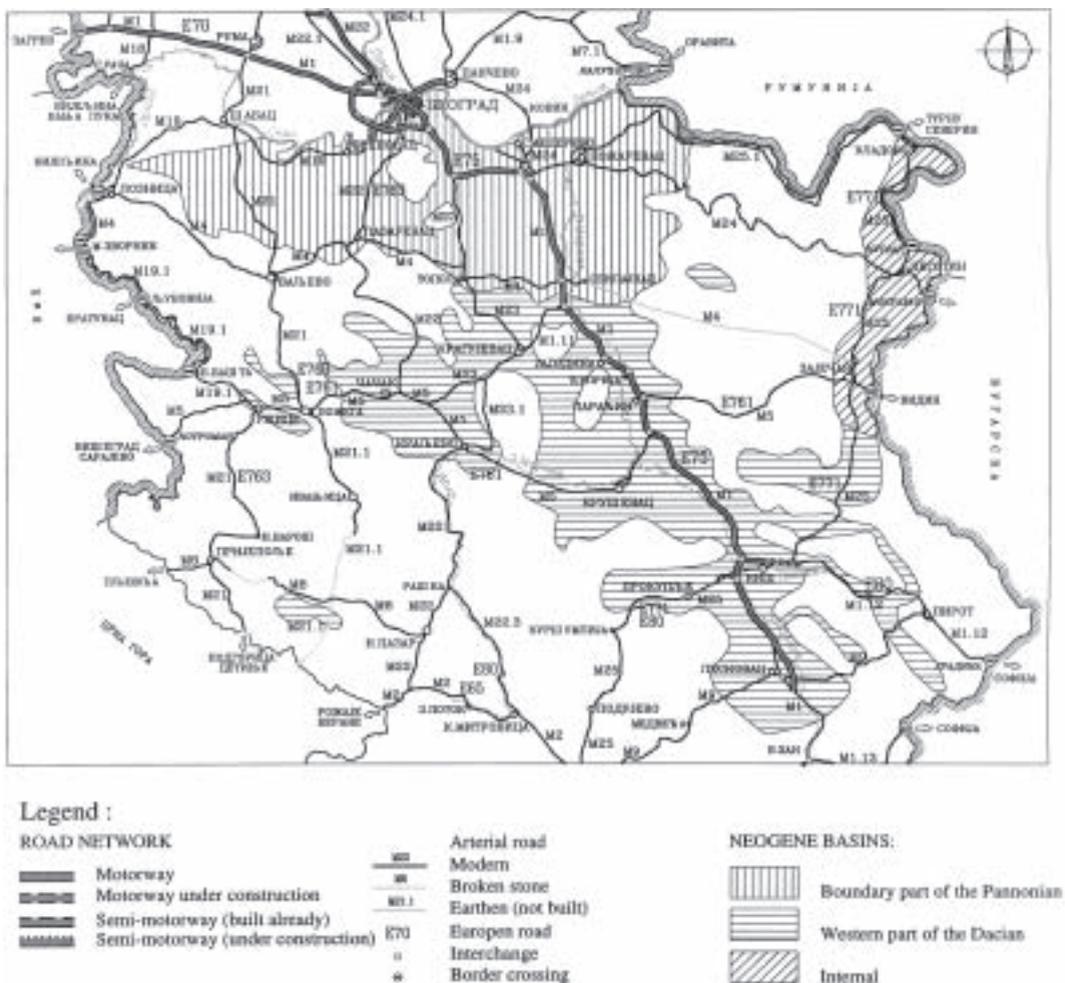


Figure 1. Neogene basins of Central Serbia

Depending on the prevailing lithological composition, which is different in certain chronostratigraphic units, and therefore the conditions of construction and operation of roads are different, so that one may single out the following categories of low rank Neogene basins: Pliocene, Pannonian, Sarmatian-Tortonian and Helvetian basins.

1.1 Pliocene basins

The terrain in these basins is made of sands, gravels in subordinate position by vertical and lateral replacements with silts, marls, marly clays, interbeds of sandstones, carbonaceous clays, and layers of coal with the thickness up to 20 m.

Basic water-bearing formations are made of sands and gravels wherein the ground water storages were created, i.e. AQUIFERS of sub-artesian and artesian type wherefrom on many locations the exploitation of these waters is carried out for the purpose of public water-supply. The road construction and operation must take into consideration the existing and future sources of water-supply.

1.2 Pannonian basins

Lithological composition of these basins at their boundaries is made of clayey-marly deposits with the interbeds of sands and slightly coherent sandstones of small thickness, which represent the water-bearing formations with ground water storages of sub-artesian and artesian type. On the whole the Pannonian deposits represent water-impervious milieu between the water-bearing formations of Pliocene and Sarmatian. Prevaingly temporary ground water storages of fractured type have been created in the weathering crust of Pannonian clayey-marly deposits, thus being one of the basic factors of slope instability and unfavorable hydrogeological conditions for the road construction and operation. Lithological composition of this category within the framework of internal Neogene basins is made of conglomerates, sandstones, marls, sandy clays with coal interbeds, whereas the sands and gravels are in a subordinate position as a form of interbeds and lenses. The water-bearing formations, as a rule, have small spread, whereas the ground water storages are of "closed" type.

1.3 Sarmatian - Tortonian basins

These basins have a small spread within the framework of all macro units. Lithological composition is made of conglomerates, sandstones, argillites, marls with coal interbeds, pyroclastites and volcanites, which represent practically water-impervious milieus. There are also zoogenous reef limestones, as a basic water-bearing formation at the underlying stratum of Pannonian water-impervious complex.

1.4 Helvetian basins

Helvetian basins, i.e. Helvetian deposits within the framework of upper parts of the terrain were developed sporadically, while their hydrogeological properties could only be relevant locally for the conditions pertaining to the road construction and operation.

Those basins of lower rank as indicated in the previous text are represented differently in certain parts of Central Serbia. Pliocene basins, and to a somewhat lesser extent the Pannonian ones are located primarily at the perimeters of the Pannonian basin and in the northern part of the Dacian basin. Remaining basins of lower rank are located in the northern part of Central Serbia (Fig. 1).

CONCLUSION

Based on the aforementioned one may conclude as follows:

- Complexity of hydrogeological conditions for the road construction is linked strictly to the lithostratigraphy of Neogene basins;
- Hydrogeological properties of terrains have the largest impact within the framework of Pliocene, and then in Pannonian basins, whereas the impact thereof in chronostratigraphically older basins could only be at a local scale;
- Definition of quantifications as regards the impact of hydrogeological properties of rock masses and terrains onto the road construction and operation is requiring a special purpose investigations and studies;
- Roads as linear facilities are crossing various categories of Neogene basins, and in order to select the corridor and alignment of roads, it is necessary, amongst other things, to have an overall definition of terrain hydrogeological properties.

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