

Natural barriers of development of road network in Slovakia

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Abstract

In connection with needs of the state department to accept the decision on a long-term spatial and functional development of road net in Slovakia, the project "Territorial General Plan of Road Traffic of the Slovak Republic" has been done. Evaluation of natural barriers is one of its parts. The contribution presents the evaluation procedure and some results achieved.

Key words: barrier effect, natural barriers, road network, territorial general plan

Introduction

Natural barriers often importantly modify different socio-economical activities in the landscape. This factor is extraordinarily important in a varied, strongly differentiated landscape like the Slovakia is. Action of natural barriers can be observed also on the process of the road network forming. It is advantageous also today, in spite of actual technical possibilities, to know their intensity, mainly in proposing new traffic lines.

Various elements of the landscape can act as natural barriers depending on the landscape type. We can consider for relevant in Slovakia primarily relief barriers. Also slope deformations, watercourses and flood risk, adverse climatic phenomena like temperature inversion, fog, glaze, big depth of snow, snow-drift creation, locally also occurrence of avalanches and rock-fall belong to them. In terms of the road network development also territories with high ecological, cultural-historical and other value have barrier influence. They are components of territorial systems of ecological stability, protected water supply areas, protection zones of water resources and natural medicinal sources, areas of soils of high quality, mining and quarrying areas, various forms of land use and the like.

Natural barriers analysis as a part of the process of assessment of suitability of the territory to development of road network has been for several decades a part of theoretical, methodical and application researches of many Slovak geographers. As early as in the seventies of the 20th century a team of geographers led by P. Plesník (Plesník et al. 1975a, 1975b, Plesník 1982, 1984) was focused on the theme in connection with looking for planned highway routes. Mazúr and Urbánek (Atlas SSR,

1980) evaluated potential of the landscape to roads building in a scale of 1 : 500 000 for the whole territory of Slovakia. Ořahel', Poláčik (1987), Lehotský (1991) and Lacika (2002) concerned with the theme in a larger scale in model areas. Studies like Lehotský, Ořahel', Ira (1989), Tremboř, Minár (1996), Trizna et al. (1997, 1998) belong to works engaged in formalized evaluation.

In the last time the problems of natural barriers and their influence on road network development was solved in project "Territorial General Plan of Road Traffic of the Slovak Republic" (Hrdina et al., 2003). It was made in connection with needs of the state department to accept the decision on a long-term spatial and functional development of road network in Slovakia. Results presented below have been achieved during the elaboration of the project.

Barrier effect – what does it mean?

Existence of various phenomena in the landscape that slacken the move of matter, energy and information is one of the most important factors that condition non-homogeneity of the landscape. They present barriers against different natural and socio-economical processes running in the landscape.

It may be stated in general that if some element of landscape system appeals to the process so that it changes its direction, slackens its speed, intensity, duration, or defends in its existence at all, we can call it a barrier effect of the element on the process. We can rightfully assume that there is in the landscape a big amount of barrier effects of various elements on different processes.

Than direction, size and intensity of any process or spreading of any change in the landscape is conditioned beside the existence of relations and size of impulse itself also by conditions enabling the spreading, i.e. by permeability of canals, which are used. But their permeability depends not only on the medium type (in sense of its suitability to transport) but also on size of the barrier effect of one or more landscape elements that limit in this way imagined cross-section of the canal and the speed of the flow acting in it.

Barrier effect presents so a distinct choric limit, i.e. factor influencing location and dynamics of various in landscape acting processes of natural and anthropogenic origin, for example migration of chemical elements and compounds, animal move, transport of persons, raw materials, but also move of pollution, transport of various sort of energy and information. Its knowing enables not only better understanding the dynamics of different geosystems but also on basis of it adapting location and intensity of socio-economical activities in landscape (more see in Tremboř, 1992, Minár, Tremboř, Vajlíková, 1992).

In real landscape there exist natural and anthropogenic elements with barrier effect from the point of view of the matter, energy and information flow. Their knowing enables better understanding the structure and natural differentiation of the landscape. We can insert in such elements various landforms (e.g. ridgelines, water gaps), watercourses and lakes (natural and artificial), extensive forests, hardly accessible territories (e.g. swamps), as well as roads, railways, embankments, dikes, excavations etc. Their barrier effect manifests in natural and socio-economical component of the

landscape. For example the network of ridgelines distinctly influences the surface runoff and in this way at once also character and intensity of geomorphic processes and indirectly also the man's activity in the territory.

These natural and anthropogenic forms have not only a dividing function but also simultaneously an opposite – integrative – one. The watercourse, for example, may act as a barrier at building the road network and as a communication line used by shipping. Hence the different functional evaluation of particular forms and their barrier effect depends at first on character of process observed (different function of highway with regard to animals migration and local inhabitants move) and scale of the view (in case of a big river, for example the Danube, the dividing function is distinct in large scale, but on the contrary, in small scale it may be accounted for an integrative factor of part of the Central and SE Europe). Man influences size of the barrier effect in cultural landscape also, for example by a bridge building that lowers distinctly the watercourse barrier effect in the locality.

We attain by the analysis of the barrier effect of various (natural and anthropogenic) forms following knowledge:

- Two different forms have a different barrier effect,
- A form of one type may have various quality and the quality level may vary in space (for example, the barrier effect of a watercourse depends on parameters like discharge, stream width, stream depth, character of riversides and the like, the parameters vary usually along the flow),
- Hierarchic level of particular types of forms cannot be defined in advance; it varies in dependence on landscape character (in mountains, for example, there have crucial role with respect to majority of processes especially main ridgelines, in hilly lands their importance decreases, and in plains their function is kept by big rivers, for example).

We may expect, that in dissected mountain and undermountain territories, which occupy majority of territory of Slovakia, above all convex landforms (mountain ridges and branches) act as the most important barriers. Towards to lowlands bigger watercourses keep their dividing function.

Georelief as a natural barrier for road network development

Georelief is one of decisive natural differentiation factors in the landscape, knowing of which is important in solving practical tasks connected with road network development. Attributes of other landscape elements are tied up with georelief attributes. Georelief influences principally the horizontal and vertical flow of matter, energy and information. It forms (mainly in more dissected areas occupying majority of territory of Slovakia) the main barriers and limits of the development of economical activities. Than it is important factor of social activities in landscape. Knowing the georelief's attributes acquires from that reason an extraordinary importance. Their interpretation enables us to know dynamics of its development and character of actual and past processes running in the landscape.

From the point of view of practical using information about georelief in the process of evaluation of natural barriers of road network development on level of the whole

Slovakia there are important mainly such parameters from that may be interpreted intensity of its barrier effect and accessibility, isolation of the area, respectively roughly (in respect of given scale) also suitability to certain type of human activity in landscape.

We assume for decisive parametric attribute of georelief (in respect of given scale) on basis of experience up to now with application of information about georelief (see Tremboš, 1994, Minár, Tremboš, 1994, for example) *complex dissection of georelief*. It is complex expression of:

- *Vertical dissection of georelief* (amplitude, energy of georelief) that expresses relative altitudinal differences of georelief and influences mainly dynamics, intensity of matter, energy and information move in landscape and
- *Horizontal dissection of georelief* that expresses the degree (intensity) of dissection of georelief to positive (ridges, crests, tops) and negative (valleys, depressions) forms and influences mainly direction of matter, energy and information move.

Outline of evaluation of chosen natural barriers of road network development

We have evaluated in connection with processing information about environmental aspects of road network development in elaboration of the project "Territorial General Plan of Road Traffic of the Slovak Republic" (Hrdina et al., 2003) following natural barriers.

Barrier effect of georelief. On territory of Slovakia there have been indicated on basis of different values of the complex dissection nineteen morphographical-morphometrical types of georelief (see Tremboš, Minár, 2002). They have been ordered into eight classes. Size of intensity of the barrier effect has been coordinated to each of them in dependence on size of dissection of georelief. We have evaluated road length crossing territory with certain degree of barrier effect. The indicator is important especially from the point of view of requirements of road building (it influences distinctly height of costs).

Flood risk. The road length crossing the territory potentially threatened by flood risk has been evaluated. The indicator is important from the aspect of protection of neighbouring territory against floods (road banks may importantly influence and modify intensity of flood risk and height of damages).

Landslide susceptibility. The road length crossing the territory with a degree of susceptibility to landsliding has been evaluated. (The susceptibility has been evaluated in three degrees: weak, middle, and strong.) The indicator is important in terms of conditions to building.

Adverse climatic phenomena – fog. The road length crossing the territory with mean number of fog days (to 50, to 60, to 85, to 100, over 100 days) has been evaluated. The indicator is important above all from the aspect of traffic security.

Adverse climatic phenomena – ground inversions. The road length crossing the territory affected by ground inversions with different intensity has been evaluated. (The affect has been evaluated in five degrees: very low, low, middle, high, very high.) The indicator is important from the aspect of status of environment and traffic security (inversions engender accumulation of air pollutions and influence glaze occurrence).

Adverse climatic phenomena – snow cover. The road length crossing the territory with mean number of days with snow cover (to 40, 41 to 60, 61 to 80, 81 to 100, over 100 days) has been evaluated. The indicator is important from the aspect of traffic security and costs on winter road service.

Actual land use. The road length crossing the territory with certain form of land use has been evaluated. (The territory observed has been ordered into one of following classes: 1. settlements and recreation areas, 2. industrial, mine, and transport areas, 3. arable land, 4. grass vegetation, 5. other forms of land use.) The indicator is important from the aspect of area occupation, influence on utility attributes of landscape and also on its scenery.

Environmentally important areas – territorial nature protection. The road length crossing a territory protected on the Act of the National Council of the Slovak Republic No. 287/1994 Coll., on the protection of nature and landscape, respectively another environmentally significant area has been evaluated. (All the territories have been classified after their degree of protection and function in territorial system of ecological stability.) The indicator is important in terms of ecostability functions of landscape.

Environmentally important areas – protection of water sources. The road length crossing the protected water supply areas, catchments of drinking water supply streams, hygienic protection zones of surface and underground water resources, and protection zones of natural medicinal and natural mineral table water sources has been evaluated.

We have obtained input information for the evaluation of particular types of natural barriers by analysis of maps concentrated above all in Atlas krajiny Slovenskej republiky (2002). Possible solutions leading to overcoming the natural barriers (building tunnel, bridge and the like) have not been considered explicitly in the evaluation of the road length. However, building costs increase connected with the solution is included implicitly in the size of barrier effect and thus also in suitability of the road length.

Conclusion

Procedure mentioned above enables to find out intensity of natural barriers for arbitrary road length. In the evaluation there were assessed with regard to aim of the General Plan as a territorial planning material only those lengths of the road network which are not been still in operation, but their building is in view, and also existing road lengths that shall be reconstructed. Results, that have been reached using the method, are in the “Territorial General Plan of Road Traffic of the Slovak Republic” (Hrdina et al., 2003).

Suitability of territory from the viewpoint of natural barriers’ occurring is only one aspect of the road network development. Its importance in connection to economic, social, politic, technical and other aspects on regional, national and supranational level is hard to express. It was not even our task. Object of the evaluation of natural barriers was processing enough wide (relating to scale and aim of the General Plan) set of information about landscape that may be effectively used in decision-making process.

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