ANALYSIS OF GLOBAL DAMAGE AND FUNCTIONING OF HIGHWAY SYSTEMS IN EARTHQUAKE CONDITIONS

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The strong earthquakes that occurred in the past undoubtedly pointed out the important role of the road network in elimination of the consequences of occurred earthquakes and normalization of the living conditions. The damages to the road network components (bridges, tunnels, retaining walls etc.) can induce disruption of the traffic flow and disturbance of the road functioning in the most critical moments immediately after an earthquake.

From these reasons, the investigations in the field of earthquake engineering are directed toward (1) investigation of damage to road systems, (2) analysis of disturbance of functions and (3) methods for mitigation of the consequences based on exploring the nature and the reasons for occurrence of earthquakes as well as the structural elements of the road systems. The purpose of this is improvement of the functioning of the road network composed of a number of facilities affecting the performances of the entire system.

The objective of this paper is to draw general conclusions on the behavior of the road systems, i.e., define the global damage, the seismic performances and the functioning of these systems in earthquake conditions based on investigations related to analysis of seismic hazard and risk, vulnerability of structures and their importance. To that effect, certain models from the theory of probability and seismic scenarios have been used to simulate the earthquake effect.

Due to the pronounced “spatial” character of the road systems in the analysis of the global damage and functioning of the road system, the GIS technology has been used.

The results from these investigations are presented through a concrete case of the road network in Macedonia – a country with a relatively frequent seismic activity.

SEISMIC HAZARD ANALYSIS

Taken as the first example is a scenario involving an event with magnitude of 6.5 originating from the Skopje epicentral area. The Esteva’s attenuation formula has been used to evaluate the values of maximal bedrock accelerations in the region.

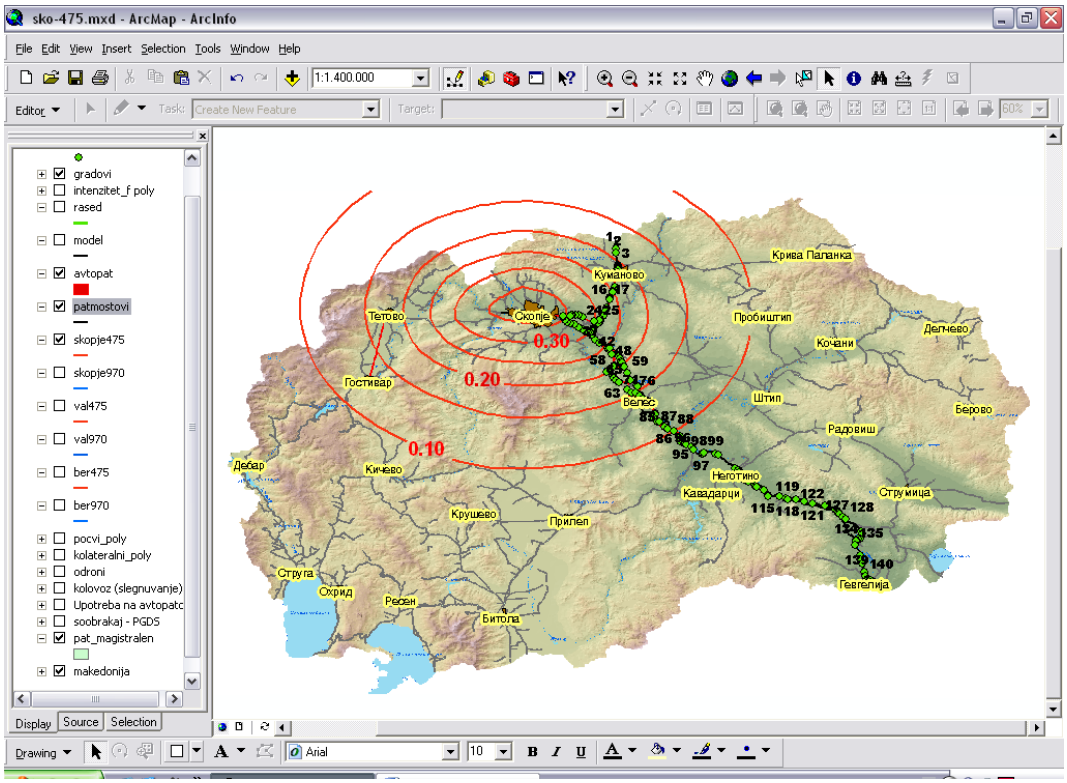

Fig. 1. Maximum ground accelerations originating from the Skopje focus with a return period of 475 years.

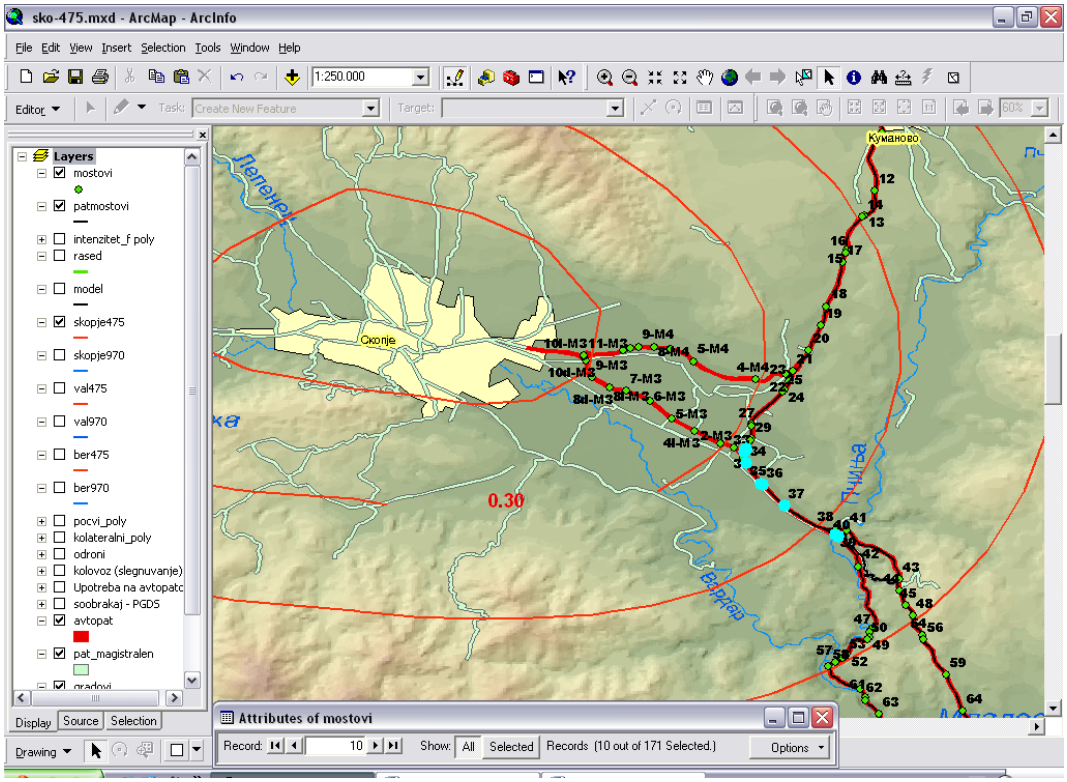

Fig. 2. Bridges with limited use due to severe damage (Skopje focus with a probability of exceedence of 10% in 50 years) (a total of 10 damaged bridges)

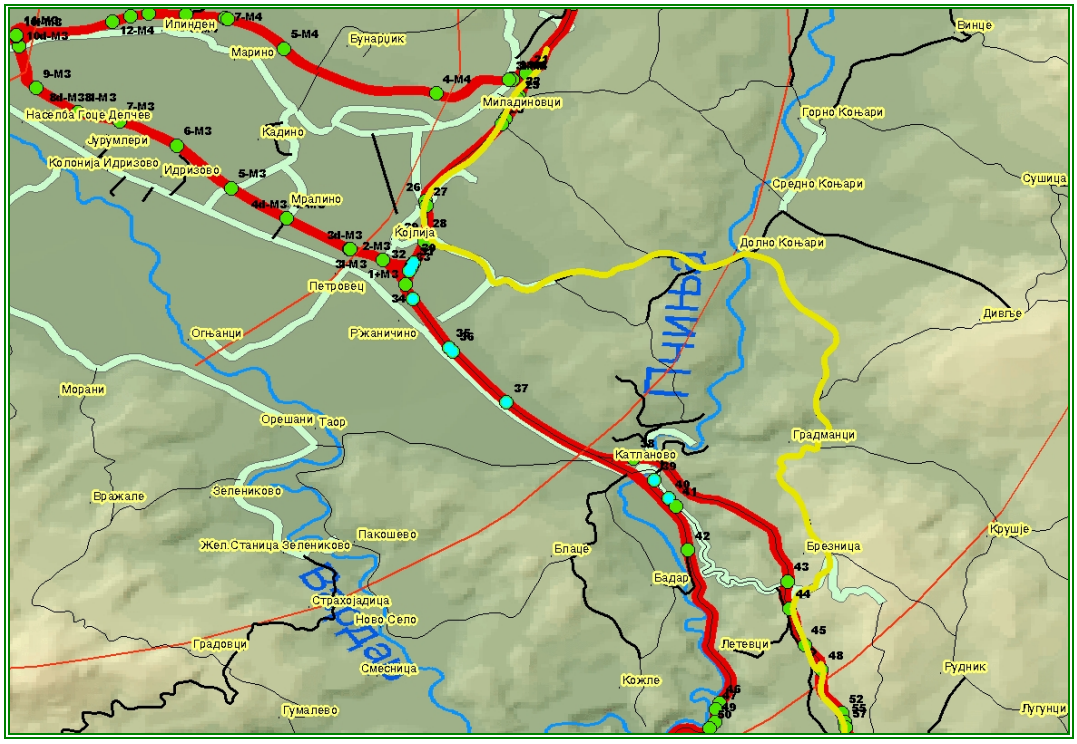

Fig. 3. Skopje focus with probability of exceedence of 10% in 50 years (post-earthquake conditions - the yellow line points to the fast route after an earthquake)