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CONSOLIDATING NEWLY BUILT MOTORWAYS – A COSTLY AFFAIR CASE STUDY

I. ABRUDAN[1] C. PLESCAN[2]

Abstract: *Construction and development of transport infrastructure in Romania are a wish that is still to come true. Given the wide variety of factors interfering with the implementation of the national transport infrastructure, the causes of its deterioration are implicitly equally complex and require a great deal of additional costs, which most often than not will lead to several times increase in the final construction cost.*
This article describes in detail the methodology applied to consolidate the areas that started to degrade right after the commissioning of the Orăştie-Sibiu motorway section, Lot 3. Since 2014 onwards this section has been extensively covered by the media as the most recklessly built portion of the motorway.

Key words: *motorway, high embankment, slope consolidation, drains*

1. Introduction

According to specialized literature in the field of economics, motorways may prove to be real "gold mines", because every euro invested in their construction can generate an economic growth 2 or 3 EUR. However, every euro invested in motorways must be carefully spent, meaning that good solutions should cost little money.

Over the time, there have been some mistakes made in road construction, which prevented the proper implementation of the road infrastructure works in Romania, as for example [1]:

a) Works without permits (BPs),
b) Low quality feasibility studies, poor quality of works,
c) Consultants not properly overseeing works,
d) Lack of transparency,
e) Poor project management and lack of planning,
f) Tender challenging mania,
g) Spiraling to the bottom,
h) Political pressure for early inauguration,
i) Overcomplicated bureaucracy,
j) Poor administrative capacity and lack of inter-institutional collaboration,
k) Corruption

The chart in Figure 1 below shows how what was expected to be an ideal road structure has deteriorated over the time.

[1] Technical University of Cluj-Napoca, Faculty of Civil Engineering, Romania.
[2] Transilvania University of Brasov, Faculty of Civil Engineering, Romania.

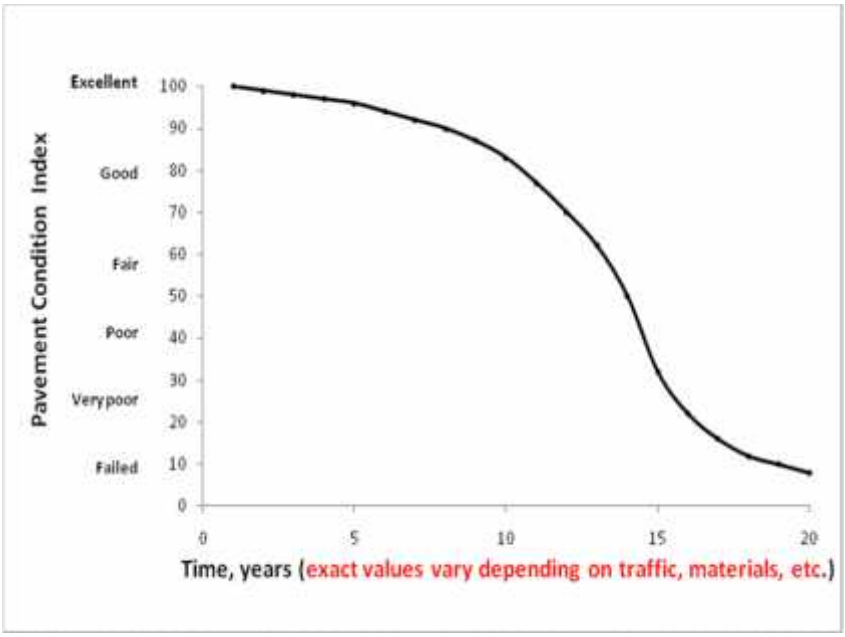

Fig. 1. *Degradation of the road structure*

In the case of the "Orăştie-Sibiu Motorway, Lot 3", at the time when the section was commissioned, degradation started to appear, mainly in the form of longitudinal and transversal cracks in the carriageway and of embankment settlement and collapse. Looking at Figure 1, we realize that the occurrence of these cracks indicates an advanced state of road decay, standing at a value of about 50.

In the ideal case, upon its commissioning, a road is 100% in good condition. As time passes, the 100% condition value decreases due mainly to traffic, reaching the value of 50% in about 25 years after the road commissioning (depending on the road structure chosen: flexible, semi-rigid or rigid).

2. Adopted Means

Choosing one or another types of works was made based on local geomorphologic conditions.

The consolidation works were completed with the restoration of the protection with vegetable earth and water drainage works capture (drains ditches and culverts). The technical solution to be implemented consists of the execution of six draining trenches, dug at a depth of seven meters, transversally on the motorway territory, and spaced apart at a smaller distance from one another at the higher part of the embankment, with the spacing increasing as the height of the embankment decreases. The trenches will be 65 m long, for four of the drains, and 285 m long for two of them. Downstream of the 65 m long trenches, manholes will be installed, interconnected to one another. The 285 m long trenches have a twofold role: to discharge the drained water into the emissary running in the downstream and to dewater the marshy area located approx. 200 m far from the motorway. The

trenches will converge into one single discharge point, where an overflow head tank will be built, continued with a riprap ditch.

Over the ground prepared as described above, embankment restoration works will be carried out using grain material reinforced with a geogrids, as follows:

- the bottom of the embankment will consist of a cushion made of crushed stone and reinforced with geogrids; the cushion width will be larger than that of the road footprint, thereby reducing strains;
- the reinforced stone cushion will prevent lateral deflection by the wedging effect
- the cushion will be 1.50 m thick and it will be reinforced with 4 layers of geogrid. The embankment body is designed to be made of 0 – 63 graded gravel.

The slopes will have a 2:3 inclination and will be reinforced with geogrids built onto reinforced earth structures, on both sides.

- The reinforcement will be placed 6.00 m from the slope surface.

The spacing between reinforcements will be 50 cm. To prevent deflections, geogrid connections will be built every 2.00 m over the embankment height, using the same type of geogrid material as in the case of the crushed stone cushion, i.e. rigid geogrids having a tensile strength at 5% strain of 100 kN/m. Slopes will be reinforced with geogrids.

The next figure (Figure 2, 3, 4, 5, and 6) presents some aspects of the consolidation works completed with the restoration of the protection with vegetable earth and water drainage works.

Fig. 2. *Excavation of the cross drains [2]*

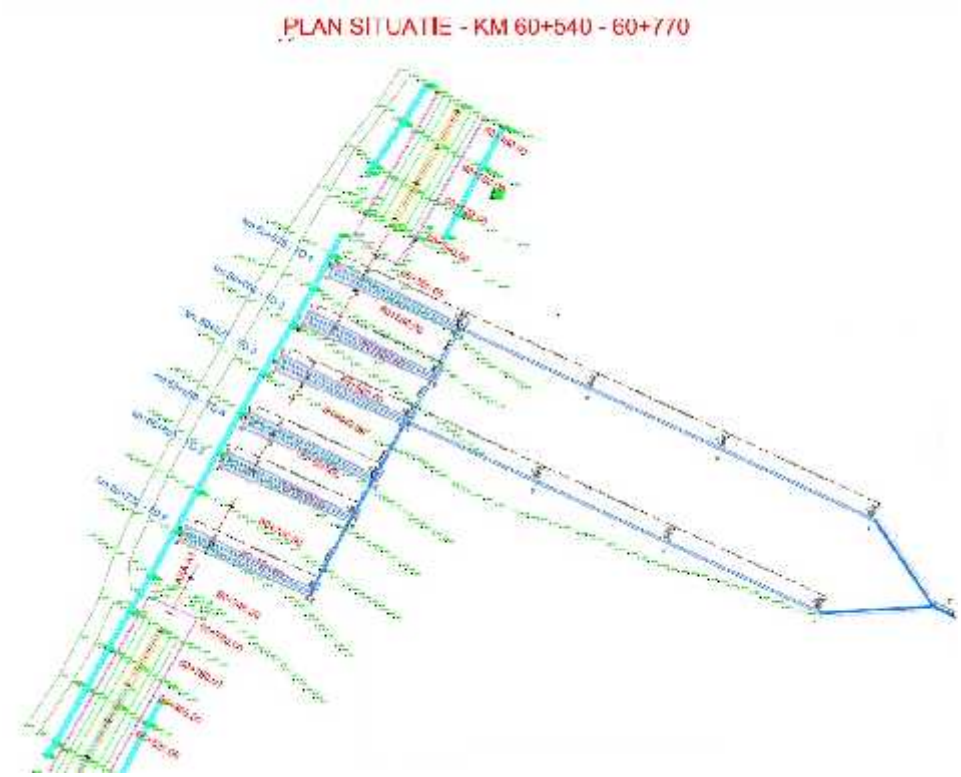

Fig. 3. *Positioning drains.*

Fig. 4. *Digging drain*

Fig. 5. *Geotextil putting in work [3]*

Fig. 6. *Building of the embankment [3]*

3. Building Materials Used

They used volcanic rocks (andesite's), amphibolite and schist amphibole's (feldspathic gneiss with quarto-biotite, chlorite and muscovite, amphibolites) in perimeter investigated.

Andesite of Zlatna located in the central eastern characterized by short strands containing small thickness - black quartz with pyrite and blend concrescent, crossed by Fires Tracing

- Rhodochrosite and sulphides.
- Pyrite impregnated with kaolin.

a) b)

Fig. 7. *a). Andesite b).Amphibolites[4]*

4. Conclusions

The draining trenches are designed to consolidate the soil. They are also meant to drain the surface waters, to capture the underground waters and to divert towards the emissary nearby the springs encountered by the few boreholes drilled.
In fact, the problem with this road work was that it focused on diverting and blocking out the ground waters, while ignoring the capturing of the underground waters. Figure 8 shows the current state of works to strengthen embankment, including the timing of commissioning of the closed portion of highway traffic.

Fig. 8. *Current state of works*

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