STUDY ON THE INFLUENCE OF DECLIVITY IN A TRANSVERSE PROFILE ON STABILITY OF FORESTRY ROADS

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Abstract

In order to establish the links between the slopes of the cross-sectional forest roads and the longitudinal profile, a series of correlation analyzes were proposed between them.

In order to establish solutions for their design, execution, maintenance and rational exploitation, part of the geometrical elements of a forest road, namely the slopes of the transverse and the longitudinal profile, were studied in this paper.

The present study attempts to establish correlative links between some geometric characteristics of the connection curves of the forest roads, which later ensure the elaboration of concrete conclusions regarding their design, namely the stability of their platform. Following the results obtained are presented some discussions that can provide some solutions to problems in the design activity. The study was carried out on the Runcu forest road, which is 1173m in length, located in the Forestry Fund of Remeţi Forest, U.P. IV Iadolina, from the Oradea Forestry Directorate, between 2015-2016.

In order to describe the correlational relationships between slope and embanking gradients, as well as in longitudinal profile, all types of regression equations were tested so that the interdependence between them can be established.

From the values of correlation ratios obtained for the connection between slope and embanking gradients and longitudinal profile gradients, there was found a second degree polynomial correlation with a correlation ratio R = 0,9172, so very statistically significant , which allows conclusions to be drawn in this direction.

Key words: forest roads, forest sector, gradients, longitudinal profile, cross-sectional profile, correlations;

INTRODUCTION

In order to establish the links between the gradients of the cross-sectional forest roads and the longitudinal profile, a series of correlation analyzes were proposed between them.

In forest management, considering the complexity of the functions performed by forest roads (Gucinski H. et al., 2001), the future strategy for the extension of road networks must first seek to strictly comply with forest arrangements in order to ensure continuity of forestry production on the one hand and the exercise of the protective role of forests along with the most efficient accessibility of the forestry fund (Ungur A. et al, 2003).

The need to construct forest roads as well as to maintain existing ones is motivated by the need to provide a transport network capable of meeting all the needs of the forest sector in close harmony with current ecological requirements (Lugoa AE et al 2000), all the more so as it is not recommended to initiate a single road in the absence of a project for the entire road network in an area (Ungur A., 2005).

In order to establish solutions for their design, execution, maintenance and rational exploitation, part of the geometrical elements of a forest road, namely the gradients of the transverse and longitudinal profile, have been studied in this paper, since a closer correlation between they provide the necessary stability for the operation and operation of the road for as long as possible, and in high quality conditions (Watkins RZ, et al, 2003).

In Romania, forest roads are considered as the basic ways of opening the forest basins, so that their construction under the conditions of rational forestry management must respect the management principles in terms of ecology and economic efficiency in general (Creţu O., et al.,2006).

MATERIAL AND METHOD

The study was carried out on the Runcu forest road, which is 1173m in length, located in the Forestry Fund of Remeţi Forest, U.P. IV Iadolina, from the Oradea Forestry Directorate (18***), between 2015-2016. The road is located in a mountainous region with very sloping slopes. The route takes place as a slope and high slope road, the terrain conditions that are passing through it are heavy due to the rough relief, which involved the handling of a large amount of terraces for the platform, so the rock is present in a proportion of 10% of the excavation volume and the longitudinal gradients of the road is on average 8.8-9.5%.

It is known that the cross-sectional profile of forest roads consists of horizontal or almost horizontal parts forming platforms and sloping sides called slopes: it can be of three types: embankment, excavation, or mixed. The inclination of the slopes depends on their height and the nature of the ground from or into which they are being run; it must be chosen so that the earth does not slip. For the same kind of land and the same height, the slope slopes can be more inclined than the embankment, because the soil used in the filling is disturbed and therefore has a lower stability (Olteanu N., 1996).

The longitudinal profile of a road includes the vertical projection of both the road axis (red line, direct line, project line) and track line (black line, field line). When designing roads, it is important to know the limits between which the gradients and the lengths of the gradient panels can vary. Thus, in terms of gradients, it should not exceed the maximum admissible values, but at the same time the recommended minimum values should be considered (Olteanu N., 1996, Alexandru V.,2000).

Both transverse and longitudinal profile gradients can be obtained with high precision using GIS elevators, applicable in the forestry sector (Crainic G.C. 2009, Iovan C., Crainic G.C,2009).

The declivity of the embankments, excavation and longitudinal gradients are presented below:

Table 1

The value of embankment and excavation gradients, as well as in the longitudinal profile

No. crt.	**Excavation gradients** (°)	**Embankment gradients** (°)	**Average declivity** (°)	**Longitudinal profile declivity** **(%)**
1	35	33	34,0	10,5
2	33	30	31,5	10,2
3	32	30	31,0	10,0
4	34	31	32,5	9,55
5	38	33	35,5	9,38
6	36	33	34,5	9,44
7	33	30	31,5	9,22
8	33	29	31,0	9,05
9	31	28	29,5	8,78
10	35	30	32,5	10,29
11	36	31	33,5	10,12
12	39	32	35,5	10,6
13	38	33	35,5	10,3
14	39	34	36,5	10
15	45	40	42,5	9,1
16	44	40	42,0	9,0
17	42	39	40,5	8,8
18	43	40	41,5	8,9
19	42	35	38,5	9,1
20	40	36	38,0	9,0
21	40	36	38,0	9,1
22	38	32	35,0	8,4
23	39	33	36,0	8,2
24	36	30	33,0	8,0
25	38	34	36,0	8,1
26	40	32	36,0	8,0
27	41	34	37,5	8,2
28	39	33	36,0	8,0
29	41	34	37,5	8,2
30	40	35	37,5	8,0

In order to describe correlational relationships between excavation and embankment gradients, as well as in the longitudinal profile, all types of regression equations were tested so as to establish the interdependence between them, which would help to improve the design of the forest roads, following all aspects of this activity (technical, ecological, social, etc.) (Horvat, D. 1994).

RESULTS AND DISSSIONS

In order to identify the possible correlation between excavation and embankment gradients as in the longitudinal profile corresponding to this forest road, 3 and 2 strings were taken into consideration, which were tested using the most known regression equations, respectively linear, logarithmic, polynomial, power and exponential.

Analyzing the values of the correlation ratios obtained for the connection between the slopes deformations in the slope, as well as in the longitudinal profile, there was found a polynomial level II correlation with a correlation ratio R = 0,9172 (Figure 1), thus very significant (Giurgiu V., 1972) from a statistical point of view, which allows conclusions to be drawn in this direction.

This second degree polynomial correlation, with the regression equation y = 0.0449x2 - 2.5969x + 66.55, shows that there is a very close link between excavation and embankment gradients as well as the longitudinal profile. By the obtained results, namely this very close interdependence between the three geometrical elements in transverse and longitudinal profile, it can be said that a more complex study of the links between all the geometric elements of the forest roads can contribute to the improvement of the accuracy of the calculation relations for them and automatically increasing the quality of the design phase (Iovan C.I., 2016).

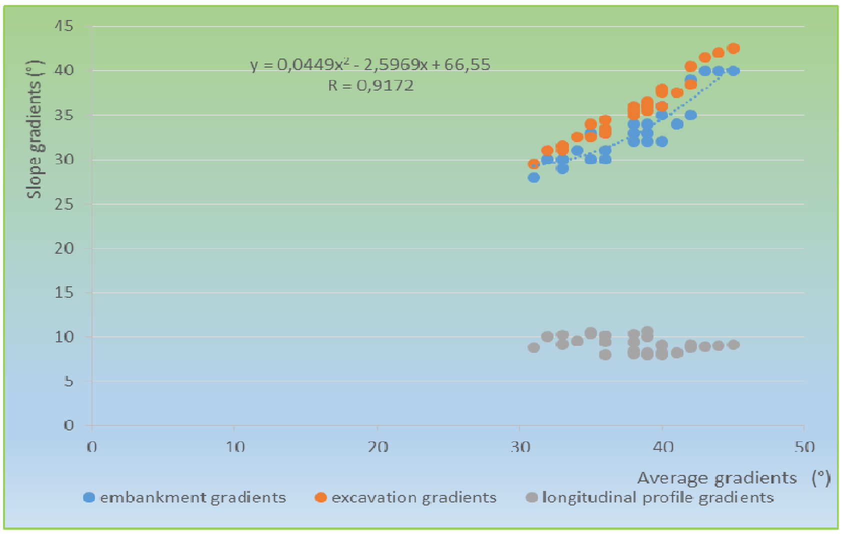

Fig.1. Graphical representation of the polynomial correlation between the slopes gradients

CONCLUSIONS

For the purpose of practicing sustainable and efficient forestry, an optimal strategy for the design, execution and maintenance of forest roads is required. As a result of the results obtained in this study, it may be proposed that GIS technology be used in the future in order to increase the precision and quality of the design that are well correlated with the choice and management of the forestry routes (Akay AE, et al., 2008, Tamaş Ş. , 2006).

Of the regression equations with two and three pairs of factors, the best results are obtained using the polynomial correlations of the second degree, which are very statistically significant, and which show the existence of a close interdependence between the geometrical elements (excavation and embankment gradients, as well as the longitudinal profile). It is recommended that more complex studies be carried out in the future on the effect of geometric geometry elements in a transverse and longitudinal profile in determining the most suitable paths for forest roads.

As a result of establishing a very significant correlation between the analyzed geometric elements, it can be concluded that they are directly involved in ensuring the stability of the forestry roads through their various influences on their platform (Eskioglou P., et al,1996).

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