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THE USE OF GEOMATICS FOR THE PLANNING OF A SPORTS COMPLEX

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Abstract

In this paper, a topographical survey was carried out and the resulting data were processed for the development of the Zănoaga area in Bran, as a multifunctional sports complex. For the existing ski slope, all field data were collected, and a corresponding database was constructed. For the rest of the area, a comprehensive survey was conducted to establish the routes for a summer toboggan run, a tubing installation, and a bike trail (with multiple variants). A ComNav T300 GNSS equipment was used. Field data were initially processed in AutoCAD Civil 3D and then imported into ArcGIS. In this latter program, the initial 3D profile, and the possible profiles for optimal operation of the mentioned facilities were created. A program model was built in GIS through which the user can choose the suitable slope according to their experience, and the construction mode of the summer slope was simulated, based on projected speed.

Key words*: sports complex, GIS, geomatics, VBA sequences.*

INTRODUCTION

The need to relax is becoming more and more acute as life has become very demanding, or rather far too stressful. Thus, all tourist resorts aim to create and offer the widest possible range of leisure opportunities (Cândea & Erdeli, 2001). It is a well-known fact that Romania offers a multitude of leisure options (Erdeli and Istrate, 1996), the differentiation between the different locations (tourist resorts) being given by the way they are managed, and the range of services offered (Ganea, 2006). Tourism in Romania (Glăvan, 2000) has ancient roots (Epuran, 1958), but this aspect should motivate us to increase the quality of the services offered and the appropriate arrangement of the various locations. In addition, another great advantage of tourist resorts in our country is their location in diverse regions, each offering in a unique way other values (Posea et al., 1974).

Unfortunately, it can be observed that the tourist potential (Ielenicz & Comănescu, 2006), although it is a great one, does not always stimulate those who want to exploit it in one way or another, as there are no qualitative concerns but only quantitative ones, although it is known that tourism, in most cases, directly influences the quality of life (Barbu, 1980).

Each stage in the historical development of society has its own imprint on what tourism means (Hossu Longin, 1980), and the way in which the reality of time is seen is also absorbed into the tourism industry. We could even say that tourism is not only a social phenomenon, but also an economic and cultural one (Ionescu, 1999).

The development of certain regions located within landscapes (Barabas and Rusu, 1979) should not only be inspiring for the rest of the country (Ciangă, 2001), but should be an imperative that leads to the co-interest of decision-makers and local factors. The food industry can also be closely linked to the development of tourism (Bărănescu, 1975), given that (especially) rural areas offer traditional products of great value and quality, and sometimes the beauty of places is appreciated together with the quality of gastronomic products. Of course, a tourist location requires certain minimum amenities (Ilieș, 2007), with mountain areas having a special note in this respect (Bălteanu, 1975).

In recent times there has been a particular rise in rural tourism (Petrea & Petrea, 2000), with an increasing demand for the lifestyle and conditions that characterized the Romanian peasant of the last century. Moreover, time spent outdoors is trying to be oriented in a certain direction, giving it also a sporting

emphasis. In this context, it is becoming increasingly necessary to set up a sports center (Monea & Yamora, 1998), which would provide the sedentary majority population with the necessary skills.
For mountain resorts, a ski slope is an essential part of the landscape. This is why there are many materials which try to arouse the interest of tourists (Bâră, 1983; Ionescu, 2004; Matei, 1982), as well as materials aimed at those who have some experience in this field (Barabas & Ganea, 1995; Cârstocea, 1998; Grigoraș, 2002). The tourist resort of local interest Bran also belongs to the ranks of all self-respecting resorts and aims to develop the sports base in the Zănoaga area. There has been a ski slope here since the 2000s, but the intention is to extend it. This expansion concerns both the ski slope, which will have a new trail and therefore a new ski lift, and other facilities for winter sports (tubing trail) and summer sports (bicycle trail).

MATERIALS AND METHODS

The following materials were used for this work:

- A ComNav T300 GNSS equipment providing an accuracy of 8 mm + 1 ppm Root Mean Square (RMS) in the horizontal plane and 15 mm + 1 ppm RMS in the vertical plane;
- A Dell Latitude 5411 laptop with an IntelI CoreI i7-10850H CPU @ 2.70GHz 2.71 GHz; and 16MB RAM;
- ArcMap software;
- Microsoft Office software package (namely Excel and Word applications);
- AutoCAD Civil 3D software;
- A topographical survey totalling over 2500 points.

Regarding the research methods, the following were used:

- Direct measurement method by which the coordinates of the points of interest were taken;
- Statistical methods of filtering the points whose coordinates have been determined;
- Geographic Information Systems (GIS) methods (georeferencing and vectorization of cadastral plans; use of Visual Basic for Applications (VBA) programming sequences to carry out various analyses).

RESULTS AND DISCUSSIONS

The measurements were carried out in several stages as the beneficiary's requirements were fragmented (Figure 1). The *.rw5 files were analyzed and only the coordinates of the points that were recorded as a fixed solution and with corresponding dilution of precision (PDOP) values were kept.

Figure 1. Study area

Subsequently these coordinates were imported into AutoCAD Civil 3D, the 3D model was created (Figure 2) and contour lines were drawn (Figure 3) to highlight the terrain’s configuration.

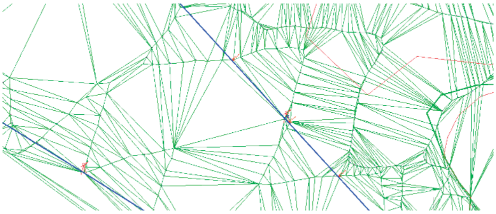

Figure 2. The 3D model

Subsequently the problems were addressed separately, according to the objective in mind.
Since in all cases the 3D profile of the area is of interest, it was also created in the ArcMap environment. For this purpose, the *.txt file was transformed into *.xls format. This sheet was in turn transformed into *.shp format using the ArcCatalog module, following the sequence: right click on *Sheet1* → *Create Feature Class* → *From XY Table* (Figure 4).

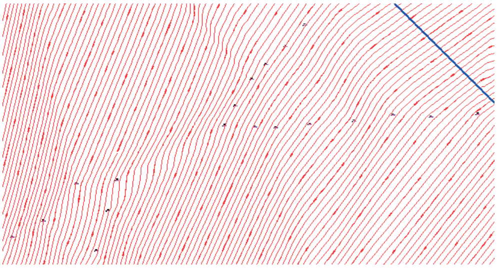

Figure 3. Drawing level curves

Table
CoordFinale

FID	Shape	839	443488_248	530349_011	906_670	Statie
48	Point ZM	42	443370.503	530509.504	931.02	RIGOLA
49	Point ZM	43	443370.946	530500.465	930.26	RIGOLA
50	Point ZM	44	443371.116	530495.789	929.83	RIGOLA
51	Point ZM	45	443373.134	530481.94	928.37	RIGOLA
52	Point ZM	46	443374.922	530472.088	927.84	RIGOLA
53	Point ZM	47	443374.271	530468.408	927.35	RIGOLA
54	Point ZM	48	443373.574	530464.382	927.15	RIGOLA
55	Point ZM	49	443374.444	530461.935	927.16	POD
56	Point ZM	50	443373.012	530461.275	926.75	POD
57	Point ZM	51	443374.531	530457.651	926.6	POD
58	Point ZM	52	443375.749	530458.018	926.67	POD
59	Point ZM	53	443395.264	530460.603	926.03	GL
60	Point ZM	54	443391.086	530463.455	926.33	GL
61	Point ZM	55	443386.379	530467.548	926.59	GL
62	Point ZM	56	443383.255	530472.549	927.29	GL
63	Point ZM	57	443380.594	530478.406	927.9	GL
64	Point ZM	58	443379.527	530483.668	928.41	GL
65	Point ZM	59	443377.999	530489.935	929.1	GL
66	Point ZM	60	443377.665	530495.567	929.52	GL
67	Point ZM	61	443377.088	530501.278	930.41	GL

(0 out of 2567 Selected)
CoordFinale

Figure 4. Stereographic coordinates in ArcMap

Next, a Geodatabase File is created in which a Feature Dataset is created. The *.shp file containing the coordinates of the points is transformed into a File Geodatabase by following the sequence: *points.shp → Export → To Geodatabase (single)* (Figure 5). Then the contour lines are created. To do this, a raster was first created from point Z-values, resulting in the grid layer (Figure 6). The last step is the actual creation of the contour lines, following the sequence: *Arc Toolbox → 3D Analyst Tools → Raster Surface → Contour*, using the previously created grid (Figure 7).

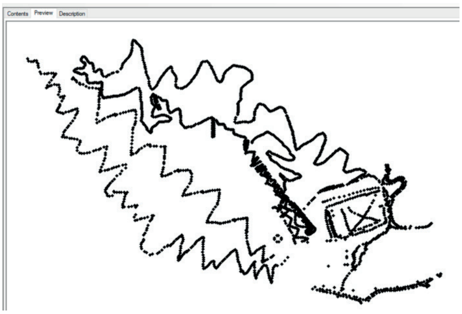

Figure 5. Coordinates in ArcCatalog

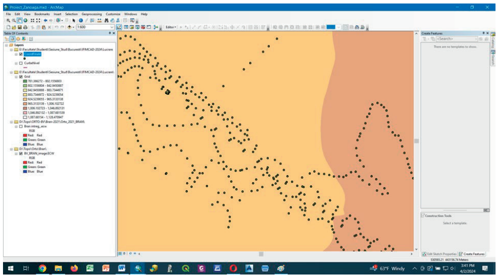

Figure 6. Creating the grid

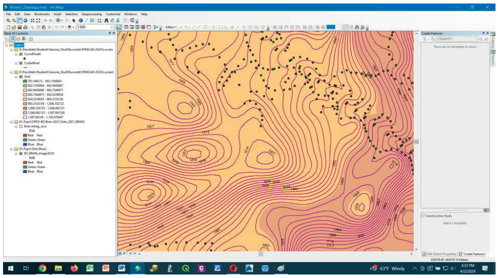

Figure 7. Creating contours

Next (GIS) facilities were used to perform the complex study considered (Tereşneu et al., 2016), the main directions of action being:

a. For the case of the chairlift, the aim was to achieve the optimal conditions for the commissioning of route 3 and the development of modules that would help the users to find out various information on the possibilities of skiing according to their experience. Three ski lift routes will be put into operation, with the following characteristics:
   - Route 1 has a topographic length of 253 m and is intended for children and those less initiated in the sport. For this route we can find a lot of useful information, such as the starting point (Figure 8) and the end point (Figure 9). Having the coordinates of the end points (including Z), we can find out the difference in altitude and the actual skiable distance. For this route the following values were found by querying the map (Tereşneu et al., 2009): the elevation of the downstream point 941.42 m and the elevation of the upstream point 969.84 m. Therefore, the difference in elevation is 28.42 m. The slope of this route is m = (y2-

y1)/(x2-x1) = -2.85. Also, the skiable length is 254.6 m and the difference in elevation = 28.42 m. All these values can be found from the 3D model made in ArcGis by creating (VBA) sequences (Tereşneu & Tereşneu, 2023, Tereşneu & Vasilescu, 2013, Tereşneu et al., 2013) (Figure 10);

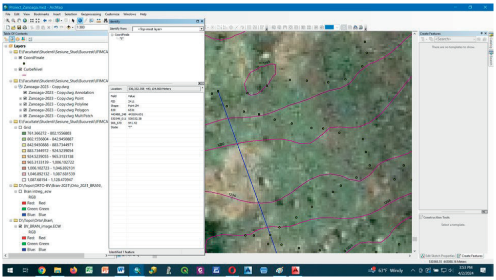

Figure 8. Elevation of the downstream point for the first ski lift route

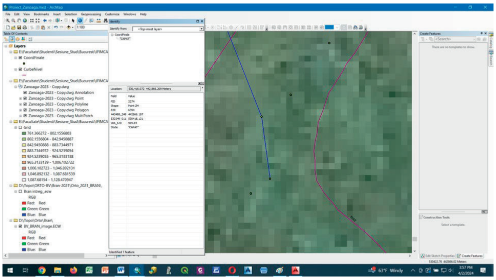

Figure 9 Elevation of the upstream point for the first ski lift route

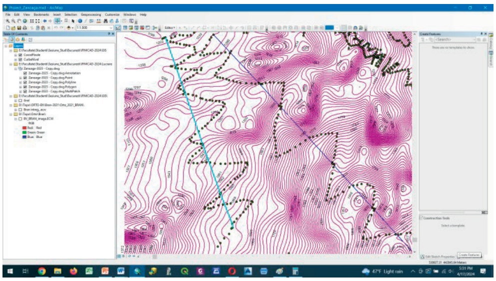

Figure 10 Determination of the actual length of the route of the first ski slope by VBA sequence

- Route 2 is 619 m long, has a downstream point elevation of 944.03 m and an upstream point elevation of 1087.06 m. This results in a slope m = -0.90, an elevation difference = 143.03 m and a skiable length of 635.3 m;
- For route 3 we have a topographic length of 539 m, an elevation of the downstream point of 967.44 m and an elevation of the upstream point of 1118.09 m, slope m = -0.63, elevation difference = 150.65 m, skiable distance of 577.65 m.

b. The same characteristics were similarly determined for the tubing route:
  - Topographic length = 177.85 m;
  - The elevation of the downstream point = 945.42 m;
  - The elevation of upstream point = 979.64 m;
  - Elevation difference = 34.22 m;
  - Effective distance = 181.1 m;

c. For the summer sledge route the following were determined:
  - Topographic length = 780 m;
  - The elevation of the downstream point = 948.43 m;
  - Elevation of upstream point = 983.30 m;
  - Effective distance = 811.35 m;
  - Branch with the steepest slope;
  - Branch with the lowest slope;

d. For the cycle routes several variants are being studied, but it is not yet possible to simulate all the possible variants because the documentation is still being submitted to the forest protection service pending approval. Only after this approval has been given can the simulation of the 5 trails with different degrees of difficulty begin.

As far as the ski area is concerned, a program has been drawn up to guide skiers to the most suitable slope. For this purpose ArcMap software was used and a (VBA) sequence was created which takes into account: the skier's weight (a scale was created from 5 to 5 kg), the age of the skier (a scale was created that took into account certain coefficients that had higher values at younger and older ages - here also specifying certain aspects related to the individual's health), the skier's courage or degree of fear (a scale was created from 1 to 10) and the skier's skiing experience (on a scale from 1 to 10) (Figure 11).

The (VBA) sequence created considers all these criteria (with the values indicated by the skier) and outputs one of the 3 possible routes, also specifying the possible travel speed (or the maximum speed allowed for the skier's experience) (Figure 12). A specific interface has been created for this program where the user is asked to answer the 4 questions and, depending on the answers given, will be guided to the most suitable route for him.

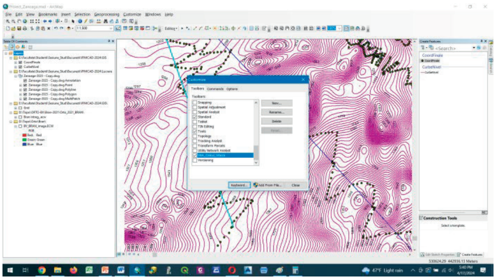

Figure 11. Creating the VBA sequence for choosing the appropriate slope

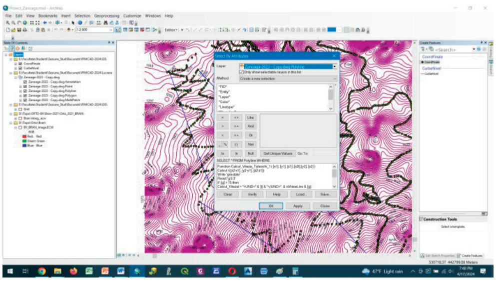

Figure 12. VBA sequence for setting the travel speed

For the part that considers the route of the summer sled, (GIS) facilities were used to design the route and to establish the fundamental elements in the design of the speed at which the sleds will move. It was observed that it is necessary to establish the main points of the route (those points that influence the projected speed the most), the height of the main pillars (those pillars that change the speed of travel to the lowest) and of the less important ones, the number and twist of the spirals (a very important element in controlling speed), the degree of opening of the curves. For a design speed of 40 km/h all these values were determined by a Visual Basic for Applications (VBA) sequence (Figure 13).

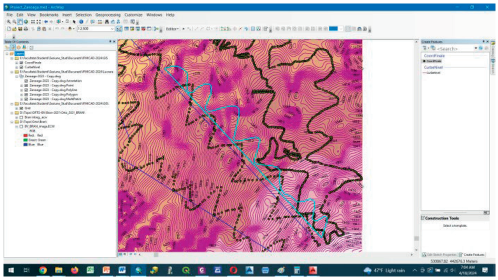

Figure 13. VBA sequence for determining the optimal route of the summer sled

CONCLUSIONS

The use of geographical information systems in the management of sports complexes is proving to be very beneficial in many ways. In addition to very clear and efficient management and the possibility of producing highly accurate maps, it is also possible to use (VBA) programming sequences to simulate certain situations or to facilitate all the calculations required for the design of various facilities. As part of this work, a small program called UNDE SCHIEZ has been created, which allows any skier to calculate, according to weight, age, courage and experience, which slope is best suited. Simulations have also been carried out on the speed of the summer sledging route, considering: the essential points of the route, the height of the pylons, the number and twist of the spirals, the degree of openness of the bends. With the help of (GIS), the appropriate values for the above parameters were established, based on predicted speed.

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