USING LANDTM SOFTWARE FOR THE ASSESMENT OF WORKS WITHIN BRATES - GHELINTA DRAINAGE PROJECT

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Abstract. *LanDTM is powerful software application, which can be integrated easily in AutoCAD and BricsCAD, allowing to generate digital terrain models. The software contains advanced options for extracting, editing, viewing and sharing geographic data. In LanDTM software is integrated a special module, "Geographic information", with many tools for the representation of digital models, not only in plan, but in many geographical reference systems too, such as UTM (Universal Transverse Mercator). LanDTM software can generate digital terrain models for the entire world, using data gathered during the SRTM (Shuttle Radar Topography Mission) conducted by NASA.The application was tested in the frame of the PhD thesis „Studies and researches on the use of information technology in designing facilities for the prevention and control of water excess in rural areas", developed by Severin Cazanescu and some of the results are presented in this paper.*

Keywords: land reclamation, digital terrain model, contours, georeferencing

INTRODUCTION

Land reclamation projects (drainage, irrigation, dewatering) are developed on large land areas. In order to obtain an image as clear as possible of the place these kind of works are placed an to be able to include these information in digital format in the project, it is necessary to establish a link as accurate as possible between the works on site and their actual position on the terrestrial globe. Software applications are needed to allow us to accomplish an easy connection between the local coordinate system used to develop the project, the sketch or the graphical image has been made and the real terrain. The process of assigning map coordinates to an image is called georeferencing.

A module facilitating this type operation has been included in LanDTM software application, application that creates, visualize and edit digital terrain models, perform triangulations and draw contour.

The terrain representations, at different DTM software application are useful to civil, infrastructural and land reclamation engineers who need good and reliable terrain representation, at different scales, to carry out projects in digital format, for terrain data extraction, runoff modeling, maps and physical models creation, land analysis, accomplishment of longitudinal profiles and cross sections.

This paper presents the testing and adaptation results of the LanDTM software application in Romania, in the frame of the PhD thesis „Studies and researches on the use of information technology in designing facilities for the prevention and control of water excess in rural areas", prepared by Severin Cazanescu.

MATERIAL AND METHOD

It is well known that the digital terrain model DTM is a digital representation of the land topography, build usually based on land survey. The digital terrain model can be represented as a regular grid of squares or as an irregular grid of triangles (TIN) in engineering applications, which keeps the original data of the surveyed points.

Point coordinates are determined based on different sources: digitized, imported from other files, inserted manually. The quality of a digital terrain model is given by the accuracy of the elevation in each pixel (absolute accuracy) and the accuracy of relief presentation (relative accuracy).

LanDTM is a software application, which calculates Delaunay triangulations and draw the contours generating a digital terrain model of the area the designer intend to model in a project. This software application is created using the newest computational methods and techniques, being of high performance and efficiency. "Aplicaciones Topográficas S.L." in Spain developed the first versions and the last two in March and September 2010 are the result of a successful cooperation between the Spanish company and the first author of the present paper.

The application runs in AutoCAD 2007-2011 environment, on 32 bits, and AutoCAD 2010 and 2011 on 64 bits and uses the computational modules and data base structure of "Protopo"software application for civil engineering and survey, developed by "Aplicaciones Topográficas S.L.".

The most recent version of LanDTM is version 6.1 and contains several tools for digital terrain model generation not only in plan but also in different reference systems such as UTM (Universal Transverse Mercator), tools grouped in Geographical Information module. Thus, LanDTM version 6.1 consists in the following sections (Garcia, 2009): Geographical information; Digital terrain models generation, viewing and editing; Survey tools.

The tests for Romania have been performed by comparing the values obtained with real data extracted from the project "Water excess removal from Brates – Ghelinta area, Covasna County". We present the results and conclusions of LanDTM testing, for the mentioned project in the following section of the paper.

RESULTS AND DISCUSSION

The Geographical Information module is the newest and spectacular part of LanDTM software application. It and can be briefly presented as a way to access international database, such as the database of digital models created by the SRTM (Shuttle Radar Topography Mission), using UTM (Universal Transverse Mercator) reference system to create the digital terrain model, in plan coordinates and on the ellipsoid (NASA , 2000).The access to the existing data on the Internet is made by the aid of WMS (Web Map Service). This program can access the database of digital models from the entire world, created by the SRTM (Shuttle Radar Topography Mission).

The software application searches automatically the area of interest depending on the coordinates specified by the user. The search, visualization and import way is shown in Figure 1 and 2. Any area on the globe can be selected, having the possibility to make three complete zoom to select smaller land areas (Garcia, 2009).

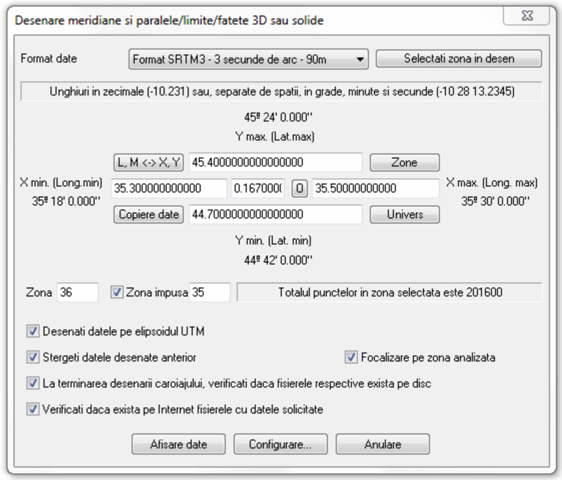


Fig. 1. Geographical coordinates for the area to be imported in LanDTM

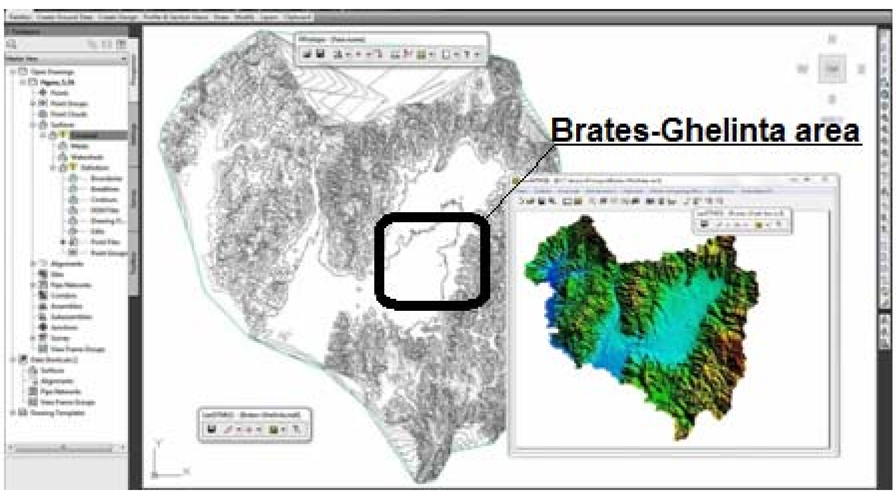


Fig. 2. Digital terrain model of Covasna County generated using LanDTM software and contours extracted using AutoCAD Civil 3D software

The area selection is made by indicating the geographical coordinates on the screen or by inserting their values manually. The corresponding value of UTM area (Area 35 for Romania) is displayed together with latitude and longitude values.

The drawing of all elements existing in the digital terrain model is made based on UTM (Universal Transverse Mercator) geographical coordinates system, using WGS 84 Ellipsoid. The XYZ local coordinate system is used to settle the coordinated in AutoCAD. In order to do this step, it is necessary to specify in LanDTM the data regarding the coordinate system used for projection (AutoCAD, 2011).

By the aid of Geographical Information module of LanDTM (Garcia, 2009), the inserted image in the AutoCAD drawing is scaled and rotated until it reaches the real position on site. To perform this process it is necessary to know the precise position of two points in the image and in the achieved AutoCAD drawing, either in geographical coordinates (latitude and longitude) or in absolute coordinates (XYZ)(AutoCAD, 2011). If we know the values of these points, the image is easy to scale and rotate, as it can be seen in Figure 3. The data can be manually inserted or by selecting them on the image or drawing.

It is indicated to select first the real points in the reference image or drawing and then the points in the image to be georeferenced. A great advantage offered by this procedure is the use both of geographical coordinates (latitude and longitude) and local coordinates (XYZ) to perform the georeferencing process, a supplementary operation for transforming the coordinate system attached to the file being not necessary.

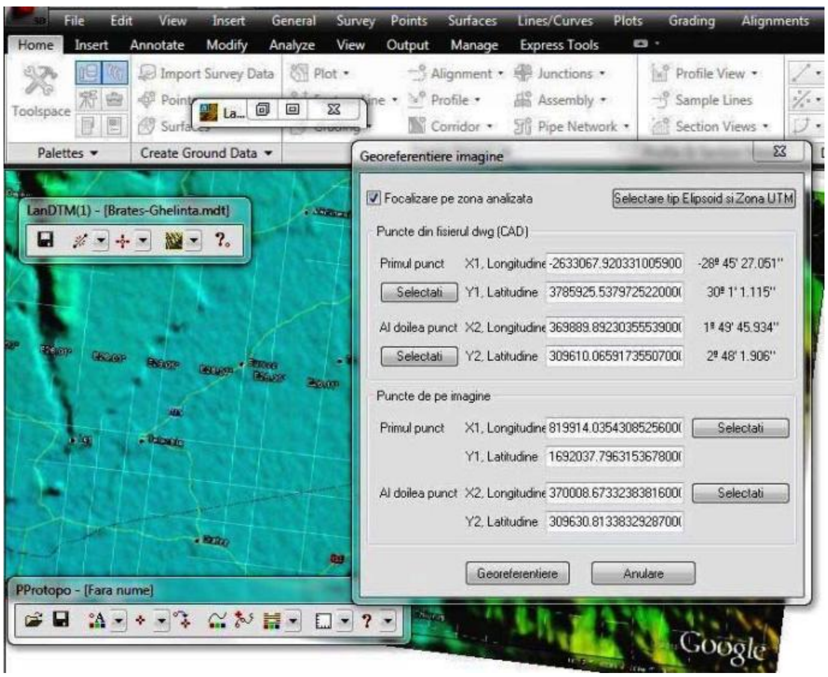


Figure 3 – Georeferencing Brates-Ghelinta drainage area with LanDTM software

LanDTM software application has a series of options to export the digital terrain model, contours and triangulations in ".kml" and ".kmz" format files, specific to Google Earth and Google Maps software applications these files can be used as standalone images or as a transposition of the project developed by us in real terrain simulation (Garcia, 2009).

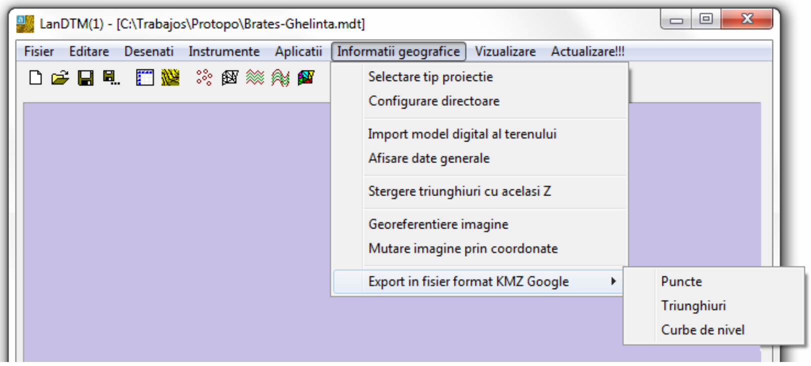


Fig. 4. Activation of the points and DTM export function in LanDTM

Once the necessary information have been inserted in the data input window, the digital terrain model and contours are generated as it is shown in Figure 5, left side. In the right side of the picture, the projection of the drainage works made by the aid of the functions presented in Figure 4 can be seen. Google Earth software application has been used to display the image.

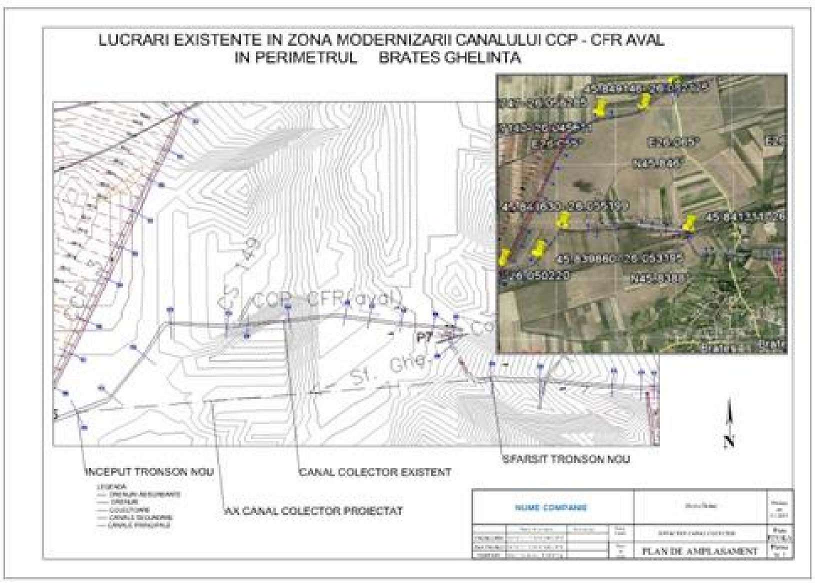
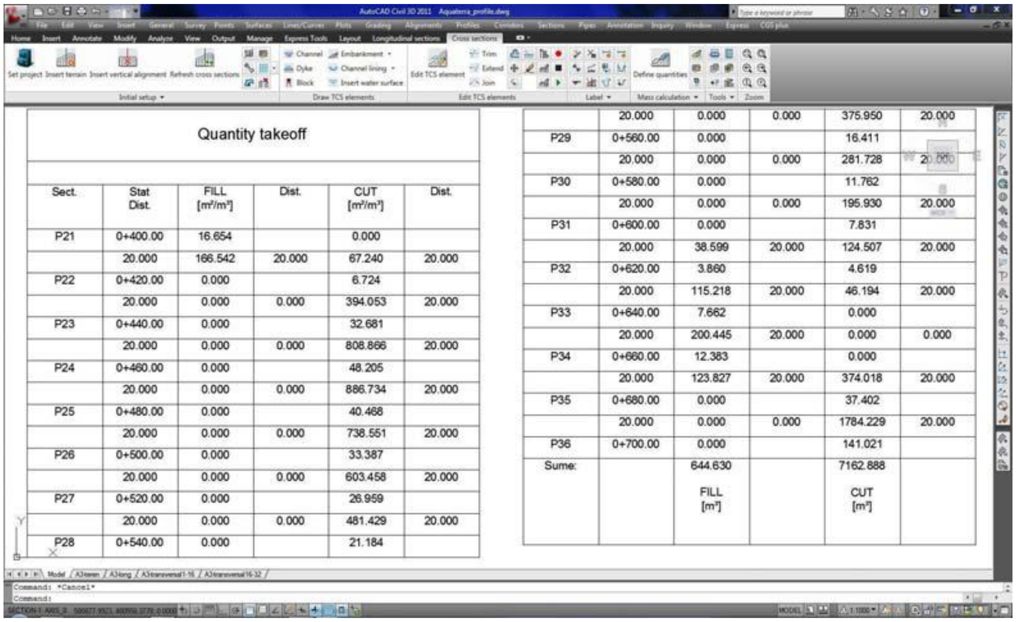


Fig. 5. Final project designed with topographis data extracted from SRTM database with LanDTM software and AutoCAD Civil 3D

Using this set of data, longitudinal profiles and cross sections were generated and the quantity takeoff for cut and fill works were computed, using AutoCAD Civil 3D (AutoCAD, 2011). In Figure 6, is presented a table containing an extract of quantity takeoff for cut and fill works. The obtained results have pointed out the accuracy of the data extracted using LanDTM software application and therefore, we consider that the application is very useful for feasibility studies and for educational purposes. We hope that the subsequent versions will offer a higher accuracy.



Quantity takeoff

Sect.	Stat Dist.	FILL [m²/m²]	Dist.	CUT [m²/m²]	Dist.
P21	0+400.00	16.654		0.000	
	20.000	166.542	20.000	67.240	20.000
P22	0+420.00	0.000		6.724	
	20.000	0.000	0.000	394.053	20.000
P23	0+440.00	0.000		32.681	
	20.000	0.000	0.000	808.866	20.000
P24	0+460.00	0.000		48.205	
	20.000	0.000	0.000	886.734	20.000
P25	0+480.00	0.000		40.468	
	20.000	0.000	0.000	738.551	20.000
P26	0+500.00	0.000		33.387	
	20.000	0.000	0.000	603.458	20.000
P27	0+520.00	0.000		26.959	
	20.000	0.000	0.000	481.429	20.000
P28	0+540.00	0.000		21.184	
	20.000	0.000	0.000	375.950	20.000
P29	0+560.00	0.000		16.411	
	20.000	0.000	0.000	281.728	20.000
P30	0+580.00	0.000		11.762	
	20.000	0.000	0.000	195.930	20.000
P31	0+600.00	0.000		7.831	
	20.000	38.599	20.000	124.507	20.000
P32	0+620.00	3.860		4.619	
	20.000	115.218	20.000	46.194	20.000
P33	0+640.00	7.662		0.000	
	20.000	200.445	20.000	0.000	0.000
P34	0+660.00	12.383		0.000	
	20.000	123.827	20.000	374.018	20.000
P35	0+680.00	0.000		37.402	
	20.000	0.000	0.000	1784.229	20.000
P36	0+700.00	0.000		141.021	
Sume:		644.630 FILL [m³]		7162.888 CUT [m³]	

Fig. 6. Quantitatif takeoff computed in AutoCAD Civil 3D

REFERENCES

1. P.M.Garcia, LanDTM version 6.0 – User Manual, 2009, Available: http://www.landtm.com.

2. ***NASA, the National Geospatial-Intelligence Agency, and the German and Italian Space Agencies, „The Shuttle Radar Topography Mission” Project, February 2000.

3. ***AutoCAD Civil 3D - User's Guide, Autodesk Inc., 2011.