ACHIEVING A FLOOD STUDY ACROSS THE TIMIŞ RIVER COURSE BETWEEN LUGOJ AND COŞTEIU SECTOR

Costel BÂRLIBA[1]   Gabriel ELEŞ[2]   Luminiţa Livia BÂRLIBA[1]
Florin Cristian BÂRLIBA[2]

**Abstract – The purpose of this paper is to achieve topographical and bathymetric studies on the river Timiş in order to create possible flood scenarios on the sector located in the northern part of Lugoj and in the south of Coşteiu commune. The objective is to obtain topo-planimetric data on the research sector studied for a flood-proof study. The study is necessary for further development of infrastructure in the area, namely to build a logistics center in the area. Thus, the data obtained through the infographic processing can determine the risk of floods on the mentioned river sector. This work is of importance in the western region because, in addition to the use of current topo-geodetic technologies and methods used to carry out topographic work in the field and office, it helps also the company of development and distribution network, and is also supporting the local community by creating jobs even from the incipient phase of the project.
Keywords:topographical and bathymetric survey, flood studies.**

1. INTRODUCTION

In usual terms, the process of water courses or backwaters depth measurements is named bathymetric survey meaning specific works of computing, measuring and reprezentation of underwater relief for a specific area. For this purpose, an appropriate number of points on the surface of the water, judiciously chosen in terms of number and position, shall be determined and determined according to the scale of the plan to be developed and the precision to be achieved. The depht measurements of river courses and stagnant waters, also called surveys, are the basic problem of hydrographic works in order to determine the underwater relief, that is to say, the difference of level for a hydrographic basin
In order to accurately determine the depths by the probes method, it was necessary to create measuring devices and devices called probes.

Considering from the bathymetric survey point of view, probes may have direct or indirect measurement. Direct measuring probes, also called simple probes, can be: the hand probe and the wood probe. These probes are used when ultrasonic equipment is not available. Indirect measuring probes are ultrasonic probes. Calibration of the probe is an operation for checking the line gradation compared to a tape. When measuring the depths, the conditions must be satisfied that the probe line is vertical and well stretched. Ultrasonic probes are complex devices that are almost universally used for depth measurement. The principle of measuring the depth with the ultrasonic probe is as follow (Figure 1):
• an ultrasound emitter usually mounted on the bottom of the ship (E), which periodically emits short ultrasonic wave pulses in the form of a beam directed downward in an approximately vertical direction;
• the ultrasound beam is reflected by the bottom of the water (O) and received on board of the ship by a receiver mounted in the R point.

Figure 1. The principle of measuring the water depth with the ultrasonic probe

Ultrasound transmitters and receivers are called vibrators. At low depth hydrographic probes, the emission vibrator also performs also the reception vibrator function. In boats case, the ultrasound probe is not mounted on the bottom of the ship but is attached outboard using a special device.

[1] Banat University of Agricultural Sciences and Veterinary Medicine, "Regele Mihai I al Romaniei", Timisoara, Calea Aradului 119, 300645, Romania, barlibacostel@yahoo.com
[2] Politehnica University of Timisoara, George Enescu Street, no. 1/A, 300022, Romania, gabriel.eles@upt.ro

2. MATERIAL AND METOD

In the phase of recognition area using the orthophotoplan and Google Earth the working area and the area of interes were topographical and bathymetric surveyis isn needed has been identify. (Figure. 2).

Figure 2. The area identification with Google Earth

According to the images achieved using ortophotoplans and Google Earth (Figure 2) and after inspecting the area, on the spot has been estabilished that for the field topographical survey to be use the GPS technology considering the fact that the area of interes is not affected by constructions or forestry vegetations (Figure 3) that can obstruct the communication of GPS reciever with the satelites and with the reference station.

Figure 3. A part of the interest area

To accomplish the work on the field and on the water surface topographical and bathymetric instruments of last generation were use, such as GPS TRIMBLE R8 and sonar Ohmex SonarMite BT attached to the boat. The working methods were, the kinematic method (RealTimeKinematic - Stop&Go) to determine the three dimensional coordinates on the ground and GPS technologie along with the sonar Ohmex SonarMite BT, for bathymetric survey.

3. RESULTS AND DISCUSSION

The field work in order to perform the topographic survey was carried out in successive stages for the work area, as follows:

A. The topographical survey of the area, by using the real time kinematic method to achieve the transversal profiles. The specific points of the transversal profile are situated perpendicular to the water course flow at a equivalent distance of 150 m. The points use for the transversal profiles were situate up to the river bank as can see in figure 4.

Figura 4. Sample with the point obtained due to the topographic survey to achieve the transversal profile.

The topographic survey were achieved by using GPS technologies, by kinematic satelitar measurements using the real time differential corrections of the GNSS virtual permanent stations. Considering the large amount of terrain surface were topographic survey is to be done, in a first office stage, the transversal profiles were project in order to help the field equipes to locate precisely transversal profiles with higher accuraty considering the distance between profiles. Another advantage of the projected profiles is that they allowed to the topographer to follow the necessary length of the profile in real time on the graphic map of the unit control of the GPS (Figure 5) avoiding the picketing operation.
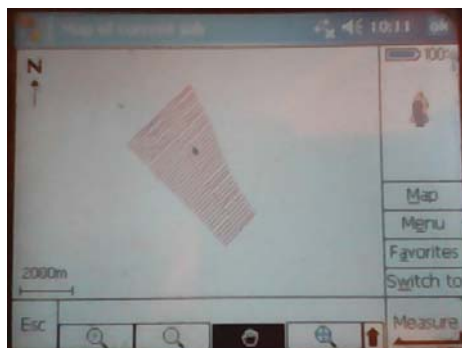
Figure 5. The map of the pruposed profiles

By using the kinematic method (RealTimeKinematic - Stop&Go) the differential corrections send in real time by the permanent station GNSS Făget of the Geodetic National Network (Table 1) was necessary.

Table 1 The geodetic point used

Point name	Geographical coordinates of the reference station			
	Latitude (B)		Longitude (L)	
	45°51'16.4275"N		22°10'37.78289"E	
RTCM0034	Cartesian coordinates of the station point			
	H (m)	X (m)	Y (m)	Z(m)
	216.490	487749.634	280960.448	173.095

For the topo-geodetical detail point field survey: axis inflexion of roads boundary. the pylons of the overhead power grids, propriety limits, land use limits, etc., the GNSS Trimble R8 SPS882 L1L2 RTK-ROVER was use (the method stop & go) (Figure 6).
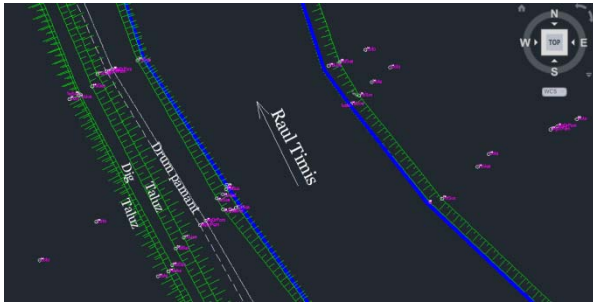
Figure 6. GPS system Trimble R8

Figure 7. Detail points from the field

The corrections receiving in real time from the satellites and from the permanent station GNNS situated on Făget in our case transformed the geocentric cartesian geocentric coordinates on geographic coordinates (the WGS 84 ellipsoid). These are corrected using the 7 parameters method calculated according to the Krasovski 1940 ellipsoid, and finally the coordinates will be projected into the stereographic 1970 projection system, on a single secant plane and a central point. These successive transformations are made by Trimble's control unit software.

The outcome results are store in digital format (.csv, .txt, .doc, .rw5, .dxf, .idx files) later, they can then be accessed and listed in analog format. Topographic measurements made for the purpose of drawing up the topo-cadastral plans were made in Stereographic Projection System 1970, the Black Sea Leveling System 1975.

B. Topo-geodesic survey on the river. Similar as in the topographic survey use for the transversal profiles on this stage it was necessary to create a graphic map that later was imported in the GPS control unit. Using this map the boat position related to the projected transversal profiles could be observed, in real time. For the topo-bathymetric survey stage along the river course the field team requires a rowboat. The topo-bathymetric measurements were started from the upstream to the downstream of the river, following the established path obtained after the topographic survey of the minor bank river for establishing the connection with the transversal profiles (Figure 8).

Figure 8. The topographic survey along the river course

For this stage of measurements, it was necessary to use the GPS technologies along with the Ohmex Sonar Mite BT sonar (Figure 9.). The technology use allows to effectuate the topo-bathymetric measurements on a short period of time and with high accuracy. To complete the operations three persons was necessary.

Figure 9. Ohmex SonarMite BT and R8 GPS unit

According to the GPS technology and to the use of Ohmex Sonar Mite BT, along with the altimetric and planimetric position of detail points currently obtained at the water surface, to obtain also the depth of the water for each detail point (Figure 10).

Figure 10 The connection between the GPS unit and the sonar

At the topo-bathymetric measurements, the active transducer of the sonar were submerged into the water and in that moment the sonar start to record the depth of each point, information that was send to the GPS control

unit. Thus, the control unit sets for each point the depth from the water surface. In order to achieve much accurate results, it was necessary to keep the GPS receiver vertical as possible and the active transducer at a constant height from the water surface (Figure 11).

Figure 11.Positioning the active traductor over the water surface

Despite that the topographic survey was achieved by using a rowboat, the field team was hardly trying to obtain a straight path as possible in order to obtain a detail survey for the bottom axi of Timis river. Due to the natural obstacles this could not be possible for the entire river sector. Thus, certain studied areas were not suitable for topo-bathymetric survey using the sonar, remaining that for this areas the data to be obtained from collateral data obtained for each river crossing (Figure 12).

Figure 12. Ortophotoplan with the innaccesible area

C. Data processing. Following export of data, two files for each working process were obtained one in ".csv" format where the coordinates of each detail point appear and another file ".htm" format where toghether with the point coordinate the technical data of the GPS and also of the permanent GNSS station ROMPOS are stored.

.
Table 2 The files from the GPS control unit

For the topo-bathymetric sesions of work in the ".csv" files was recorded the depth of each point measured with the GPS. This was make because when the sonar make its measurements, this does not record the points depth, but send it to the control unit of the GPS that recorded separately for each point. In our case, the control unit of the GPS has implemented the algorithm to compute the point coordinate from geographic WGS84 coordinate into the național coordinate of each country in this case, for Romania, Transdat to achieve the points coordinate in Stereographic 1970 system. Thus, after completing the topographic pickup and reaching the office, the user only has to export the data from the control unit to be able to process it.

Tabelul 3 Points coordinate, in Stereographic system 1970

A	B	C	D	E	F	G
Nr pct	Nord	Est	H(m)	Adancime	Code	
2000	473931.7	256114	110.933	1.72	7	
2001	473933.7	256113.4	110.943	1.68	7	
2002	473934.5	256111.5	110.945	1.71	7	
2003	473934.4	256109.5	110.922	1.86	7	
2004	473934.6	256107.5	110.928	1.89	7	
2005	473935.8	256105.8	110.942	1.9	7	
2006	473937.3	256104.5	110.863	1.9	7	
2007	473938.8	256103.2	110.903	1.96	7	
2008	473940.4	256101.7	110.923	1.96	7	
2009	473942.2	256100.6	110.927	1.98	7	
2010	473943.8	256099.4	110.936	2.01	7	
2011	473945.7	256098.5	110.935	1.98	7	
2012	473947.5	256097.4	110.896	1.99	7	
2013	473949.2	256096.2	110.908		7	
2014	473950.8	256094.9	110.928	2.07	7	
2015	473952.4	256093.6	110.927	2.11	7	
2016	473954.2	256092.5	110.91	2.11	7	
2017	473956.1	256091.7	110.872	2.11	7	
2018	473958	256090.7	110.887	2.11	7	
2019	473959.9	256089.9	110.88	2.11	7	
2020	473961.9	256089	110.899	2.11	7	
2021	473963.7	256088.1	110.903	2.11	7	
2022	473965.5	256087.1	110.943	2.16	7	

Pe rau 2 dec 17

Figure 13, illustrate the image of all the detail points achieved in Stereographic system 1970 and processed with AutoCAD software.

Figure 13 Points distribution according to the field measurements

D. Achieving the transversal profiles. To obtain some of the input data (especially the river bank slopes) on the equation use to compute the water level, it is necessary to achieve the transversal profile of the valley when is intended to identify the flood risk depending on the layout of the floodplains or the major bed. To achieve the profiles the ProfLT was use.

The command to achieve the longitudinal profile with ProfLT software is „Profile » Create Transversal". By using this command, the software ask the user to select the polyline that link the points necessary to create the profile. After the polyline is selected the software generates the profile (Figure 14).
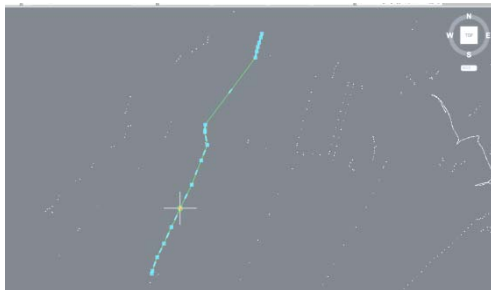
Figure 14. Selecting the polyline to achieve the transversal profile

The generated profile by tha software (Figura 16) is generated as a block reference, without showing the profile section.
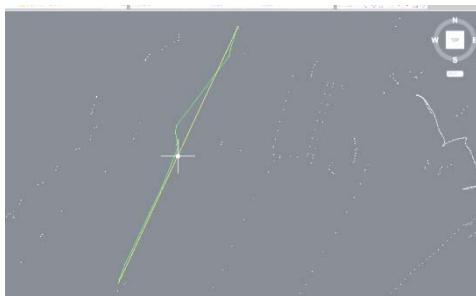
Figure 15 Transversal profile 2D-dimension

For drawing the profiles is use „Draw profile » Quick Draw". After this command, the software asks the user to select the desired profile to be draw. Soon as the profile is chose, the software asks the user to select a point from the working space where the profile is to be drawn.
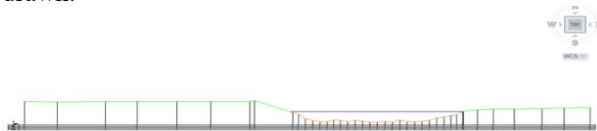
Figure 16 Cross section of a transversal profile

To achieve a longitudinal cross section the procedure is the same, the only difference is that the user uses the commands to create the longitudinal cross section. (Figure 16).

E. Achieving the 3D model and generating the level curves. To estabilish the model display mode, the command „Configure Program » Model 3D" is use. By using this command, the software opens o new window

where from we can chose the interpolation method, colors, dimensions and distances between level curves. (Figure 17).
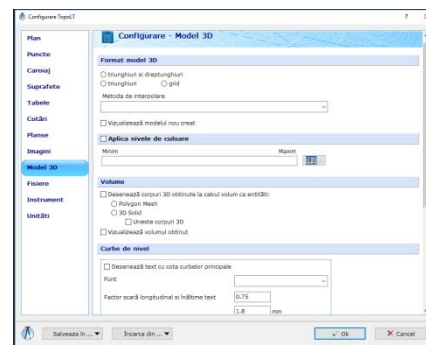

Figure 17. The configuration software window

After the program is configurate, we acces the „Model 3D » Create Model 3D" section. After accesing this command the software asks the user to select all the points that are part of 3D model.

After selecting the points that are part of the 3D model, the program open a new window where the 3D model can be see. The 3D model offers the possibility of study the final result from different points of view as perspectives and at different scales of representation (Figure 18).
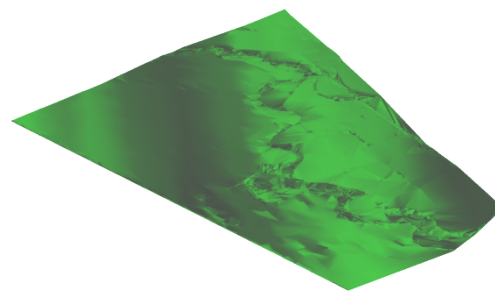

Figure 18 The 3D model of the area

After the surface was generated, the next step consists in drawing the the level curves. To achieve this step we must acces the „Model 3D » Level curves draw". Selecting the 3D model, the level curves are generated according to the distance between them, colores and thickness chose in the „Program Configuration" menu (Figure 19).
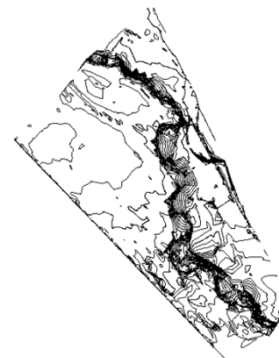

Figure 19. Level curves

For having a better interpretation of the areas with heights difference it was necessary to create the level curves. Figure 19 outlines this aspect, where in the

North-West part of the measured area it can be observed that the zone has a slight height diference and moving to the South of area the height diferebce increase. This aspect has been take into consideration in flood simulation for different heights concerning the water level of Timis river, figures 20-22. The data show in this paper, were necessary to conduct a flood study demand by a private beneficiary in order to build a logistic center in the neighbourhood area of Timis river, servicing the Timis and Caras-Severin county
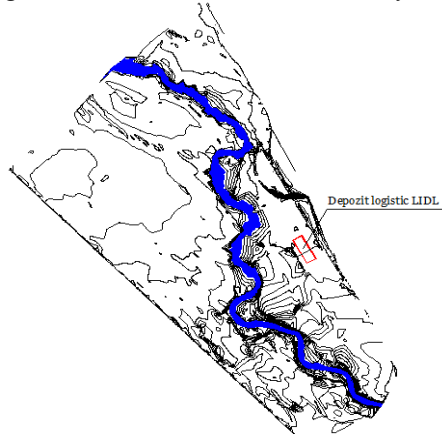
Figure 20. Study area for water level of 111 m
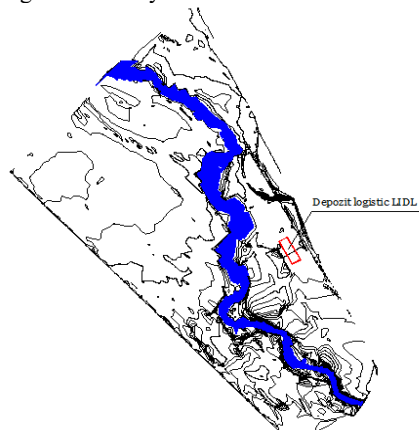
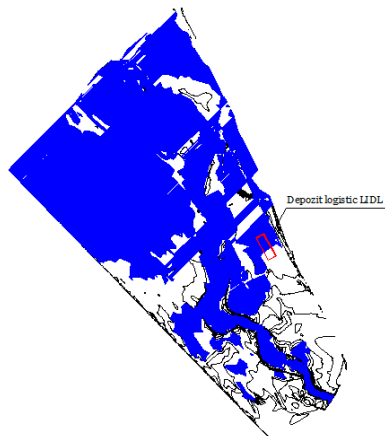Figure 21. Flood areas for water level of 113 m

Figure 22. Affected areas for 115 m water level of Timis river

5. CONCLUSIONS

Achieving the measurements by using modern technologies and later, by processing the measurements with specialized and adequate software, allowed a better sight through the modern approaching of the land surface by using modern and adequate digital equipments in the field stage but also in the office stage. On the field stage, topo-geodetical measurements has been achieved using GPS technologies and topo-bathymetric measurements using the sonar technologies, in order to achieve data for the detail points from the studied area. The modern digital technologies was use to achieve topographical survey on field during the data gathering stage. The graphical data processing operation is a method of surface representation by plans with heights but also through obtaining cross sections transversal and longitudinal necessary for flood scenario. Considering the outcoming results simulation concerning the risk areas for flood can be obtained. The flood study, is a long term project that can be permanently updated and is the corner stone of important decisions concerning the arrangement and management of the area, of the dams networks and roads that actually exists.

REFERENCES

[1] Barliba C., Barliba Luminita Livia, *Topographical Refurbishment of a Degraded Orchard in the Town of Zolt, Timis County,* RJAS Timisoara, 2018;
[2] Barliba Luminita Livia, Barliba C., *Topographical Works Realized for the Extension of a Wine Farm in Recas, Timis County,* RJAS Timisoara, 2018;
[3] Grigore Daniel, Rudi Tudor, *Sonarul Funcţionare Tipuri*, Galati, 2010;
[4] Manea Raluca, *Note de Curs Batimetrie*, Bucuresti 2008;
[5] http://www.britannica.com/ EBchecked /topic/ 554214 / sonar;
[6]https://docs.google.com/viewerng/viewer?url=http://lugojo nline.ro/. pdf&hl=en;
[7] https://www.giscad.ro/aparatura/unitati-de-control / trimble-tsc-2;
[8]http://www.rowater.ro/dabanat/Planuri%20bazinale/descrie re%20bazin.pdf;
[9] http://www.spiritus-temporis.com/sonar;