MAKING OBSTACLE MAPS FOR AERONAUTICAL OBJECTIVES

Luciana OPREA, Assoc. Prof. Dr. Eng., „1 Decembrie 1918" University of Alba Iulia, Romania, lucii_oprea@yahoo.com
Georgeta Melania SONICA, MSc. Eng., SC TOPOGIS PRINTSOFT SRL, Romania, sonicamelania@gmail.com

***Abstract**: For the safety of the flight and the aeronautical activities, on the lands afferent to the objectives of civil aeronautics but also on the lands in their vicinity, requirements, conditions and restrictions provided by the applicable national and international civil aeronautical regulations must be imposed. In this context, following this study, the aim is to obtain the cartographic and electronic data necessary to identify the obstacles that affect the safety of aircraft in flight activities over these surfaces. At the same time, the provision of cartographic data necessary for the urban development of the areas around the airports is considered.*

***Keywords:** obstacle map, aeronautical objective, obstacle, safety surface, aeronautical easement, digital terrain model (DTM)*

1. Introduction

The development of the air transport system is marked by the continuous increase in the number of airports and heliports at the same time as the improvement of the comfort and security conditions offered by them. This development is governed by the rules of the International Civil Aviation Organization (ICAO) and the specific regulations of each area and country.

The infrastructure related to these engineering objectives is represented by runways, helicopter landing and take-off platforms, aircraft runways, markings and beaconing and lighting systems, guidance and meteorological services, technical means of grounding, embarkation or disembarkation or snow removal, fire and sanitation, including perimeter protection.

2. Materials and Methods

The aim of this study is to identify the conditions, restrictions and obligations imposed or recommended by national and international civil aviation regulations for the achievement and maintenance of flight safety and maneuvers in airspace and on the ground.

Depending on the terrain configuration of each aeronautical unit, horizontal projections of obstacle limitation areas, protection of instrument flight procedures, surfaces and protection zones of other categories of surfaces define the appropriate ground area under the scope of aeronautical easements. civil.

These safety areas are subject to aeronautical regulations on obstacle control, certification and technical operation of aeronautical objectives and conditions for the approval of technical documentation for objectives in areas with civil aeronautical easements.

In order to ensure safe flight conditions in the specified areas, restrictions are imposed on:

- the location, construction and / or installation of new targets without the approval of the Aeronautical Authority or its correspondent;
- uneven terrain beyond the specific limits allowed by the relevant aeronautical regulations;
- the presence of fixed or mobile obstacles that are not part of the category of aeronautical interest objectives;
- vegetation that favors the concentration of birds or wild animals;
- the passage of electrical wires or cables, other than those installed for the proper conduct of aeronautical activities;
- any other objectives that affect or may affect the safety of aeronautical operations.

In order to limit the height of the obstacles, a series of safety surfaces are established, namely:

a) the outer horizontal surface;
b) conical surface;
c) the inner horizontal surface;
d) the approach surface;
e) the inner surface of the approach;
f) transition surface;
g) the inner transition surface;
h) interrupted landing surface;
i) the climbing surface of take off.

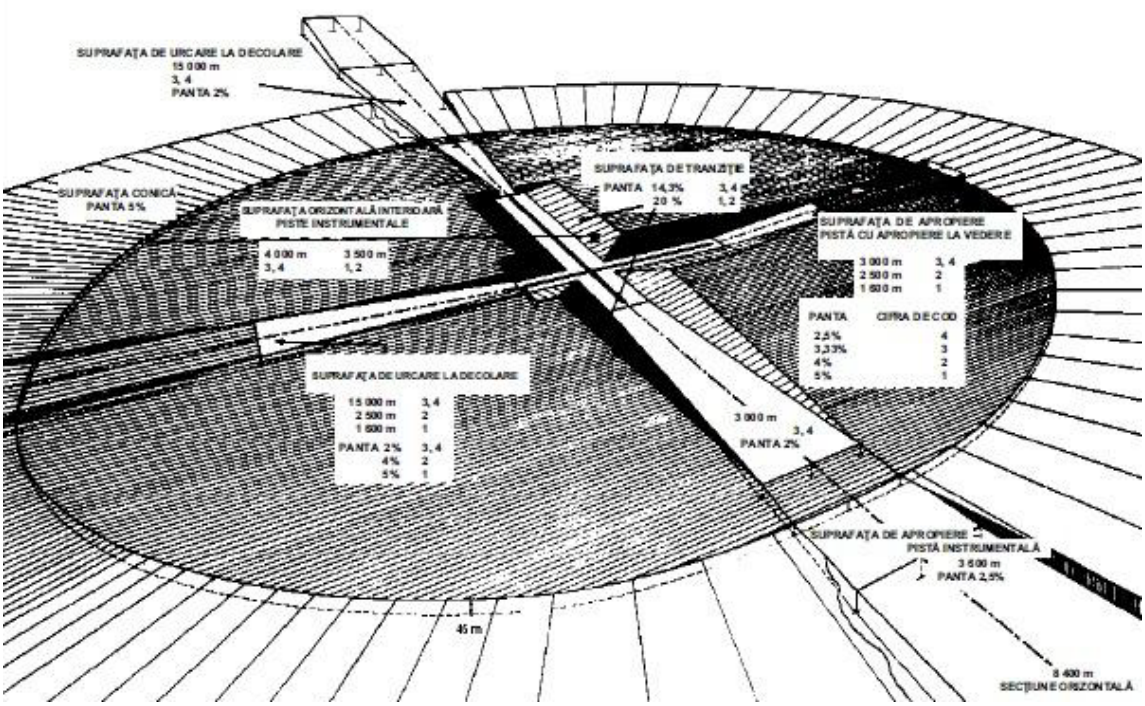

Fig. 1. Obstacle limitation areas according to the “Romanian Civil Aviation Regulations” 2015

According to international law, this case study is conducted over a distance of 45 km around airports (aeronautical easement area). This area is in turn divided into several subzones regarding some prohibitions such as the approval of the height regime for building buildings, carrying out economic activities, etc.

An obstacle is any object that poses a potential danger to flight operations. Obstacles can be natural or artificial, and can be permanent or temporary.

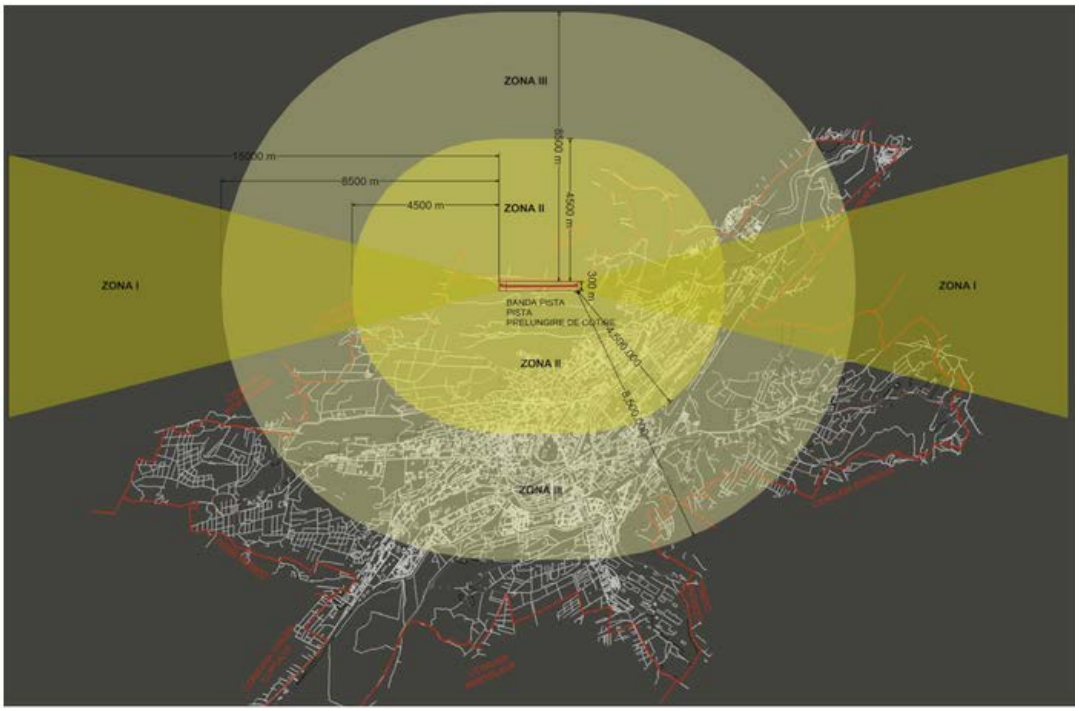

Fig. 2. Reference areas for the location of targets requiring the approval of the aeronautical authority

In order to obtain the obstacle map for an aeronautical objective, both LIDAR technology and the tools and methods related to classical topography were used.

In a first stage, the area of interest located around the airport was established for the acquisition of Lidar data, in order to obtain the Orthophotoplan and the Digital Terrain Model.

Fig. 3. Establishing the area of interest

Based on the obtained photophotoplan, a digitization database is set up with all the elements on the ground to determine the maximum height of obstacles (buildings, antennas, poles, trees, etc.), located in areas with aeronautical easements and in the airport perimeter.

Fig. 4. Digitization of the easement area

The topographic surveys were made with total stations and GPS measurements, these being rigorously compensated.

Topographic data categorized as critical or essential data must be subject to a complete initial measurement and then monitored for changes at least annually. If changes are detected, the relevant data must be measured again.

3. Results and Discussion

For each subzone an element identified on the ground is considered an obstacle and will be highlighted on the obstacle map if it intersects the area on it. For example, the obstacles on the subzone of great interest near the runway are established according to the specifications of the Romanian Civil Aeronautical Regulation RACR-HA „Aeronautical Maps” edition 2015, according to this regulation obtaining a cone-shaped subzone.

Fig. 5. The conical surface of the area near the runway

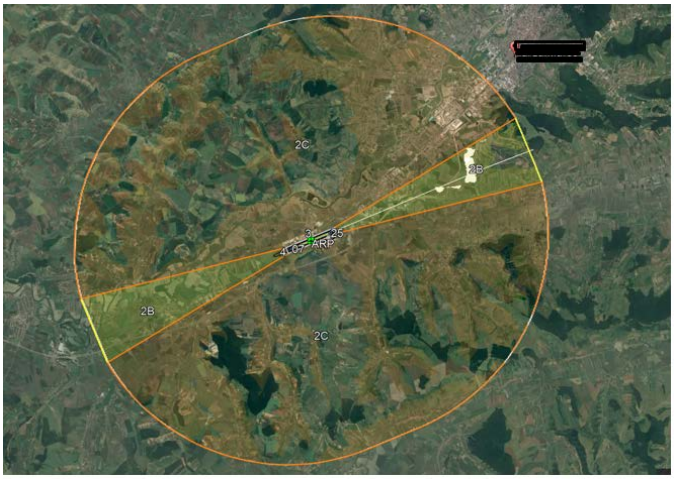

Fig. 6. The conical surface corresponding to the aeronautical objective

According to the same specifications, "Objects in the area of the take-off slope that penetrates a flat surface that has a slope with a gradient of 1.2%, and which has the same origin as the take-off slope area are considered obstacles" , so inside the cone all natural or artificial objects are checked if they penetrate the slope with a gradient of 1.2% from the end of the track, on a length of 10 km.

Thus one of the important attributes of the objects is their height for establishing the maximum level reached by it compared to the ground level in order to establish the property whether it is considered an obstacle or not.

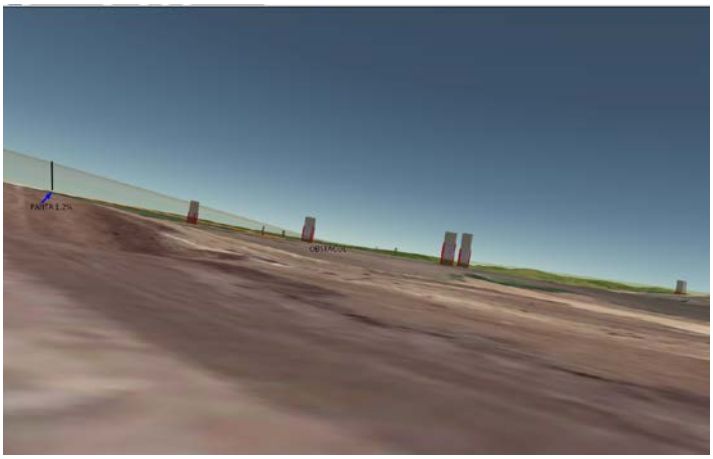

Fig. 7. Identify objects and their height in the digital model

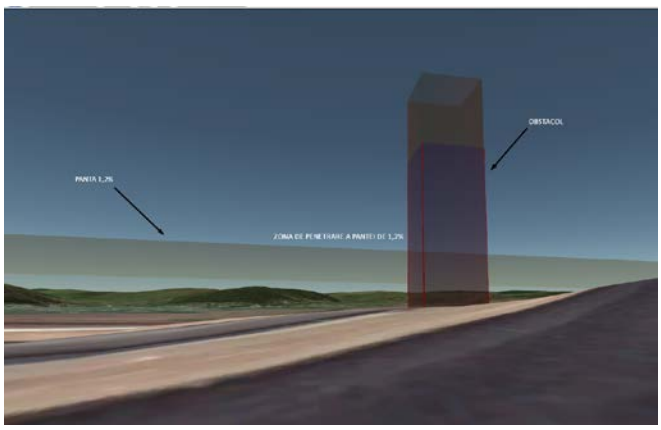

Fig. 8. Identifying an obstacle

According to the technical specifications, not only the artificial elements are checked if they penetrate the subzone, but also the natural ones, such as the earth's surface. In this regard, in order to determine whether the terrain is considered an obstacle or not, the DTM and the level curves are determined.

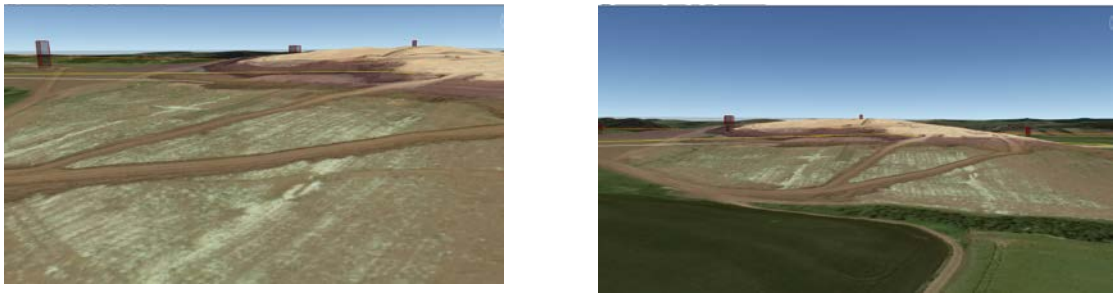

Fig. 9. Obstacles visualized in 3D, with the orthophotoplan overlapping the digital terrain model

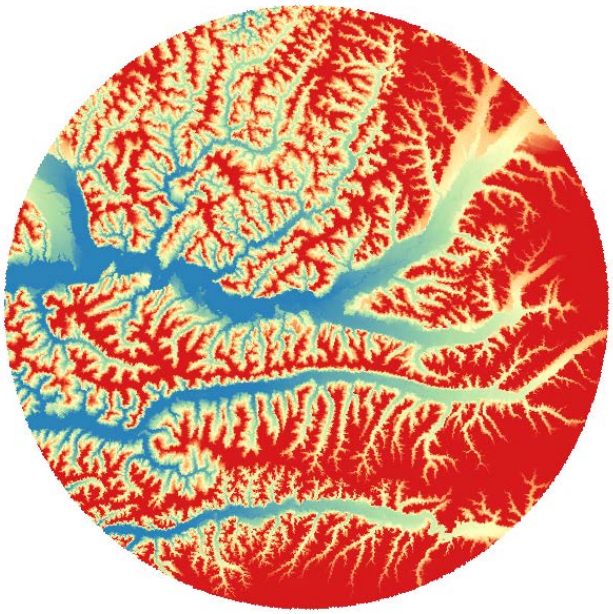

Fig. 10. Digital terrain model

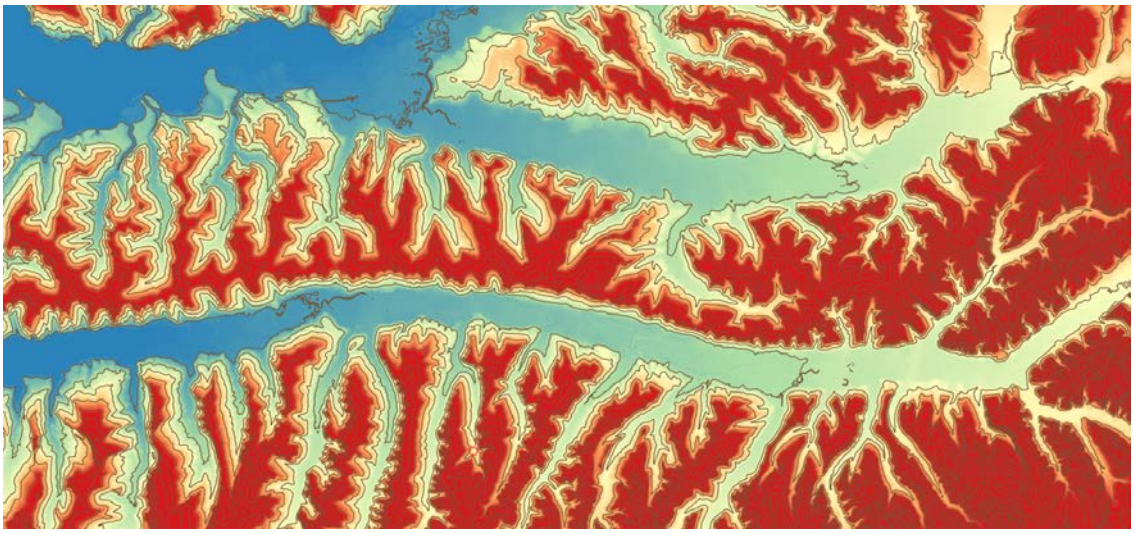

Fig. 11. Level curves

After drawing up the digital model and making the contours, check the natural objects that may be obstacles.

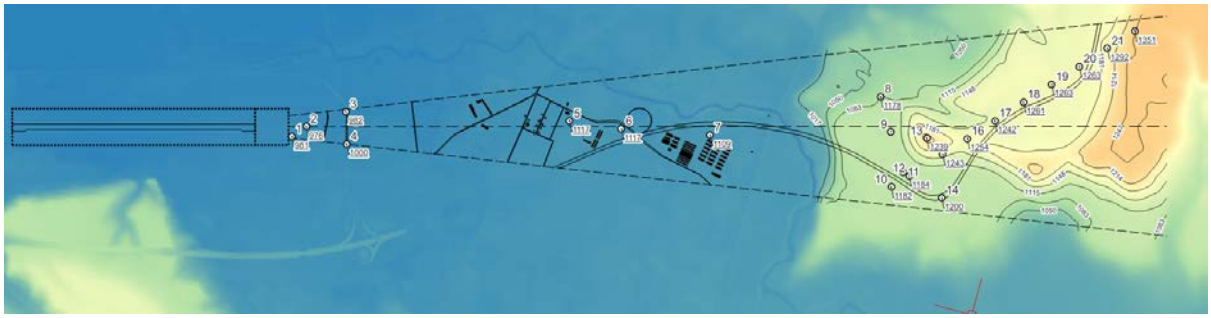

Fig. 12. Checking natural objects

The obstacle map contains the reference point of the aeronautical objective and its geographical coordinates, the contour of the runway, its length and width, the magnetic direction of the runway, the elevation of the runway axis, the tracks, the stopping extensions and their length, proximity, obstacles to their exact location, elevation and identification.

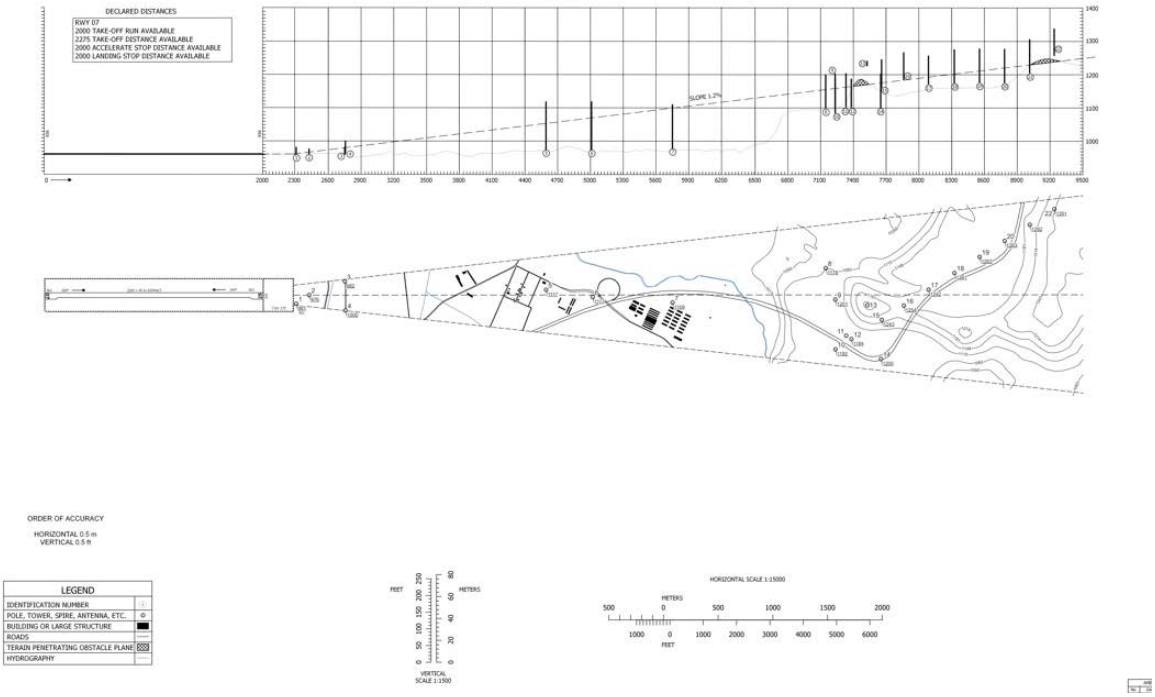

Fig. 13. Obstacle map

4. Conclusions

The definition of areas with civil aeronautical easements implies the specification of the following elements: location, shape, orientation, dimensions / limits, characteristics / conditions, restrictions, obligations. The characteristics of these areas may change over time, as a result of changes in the provisions of applicable national and international aviation regulations, the development of civil aeronautical land, weather conditions, but also urban development. In these conditions, the creation of obstacle maps is a necessity, so that all the

parameters related to the development of the aeronautical activity in conditions of maximum safety, on this sector of activity can be observed.

In order to declare the areas with civil aeronautical easements and to establish the appropriate protection regime, the public authorities have the obligation to include these areas in the general and zonal urban plans. In this context, specific data will be introduced regarding the characteristics, restrictions, obligations, possibilities of agricultural use of these lands in order to ensure the conditions of maximum safety in the conduct of aeronautical activity.

5. References

1. *Badea, G., Software Possibilities for 3D Representations - Urban Management Using 3D Models, Recent Advances in Geodesy and Geomatics Engineering, pp. 247-254, 2013*
2. *Badea, A.C.; Badea, G., An Overview of Geoprocessing and Export Options for Creating 3D GIS Models Using Drone2Map, RevCAD Journal of geodesy and Cadastre, no. 28, 7-14, 2020*
3. *Badea, G.; Badea, A.C.; Iliescu-Cremeneanu, A.; Vasilca, D.; Badea, D., Standards in Geospatial Information Management and Spatial Data Infrastructures, International Multidisciplinary Scientific GeoConference: SGEM 18 (2.3), 583-590, 2018*
4. *Badea, D.; Badea, A.C.; Badea, G.; Vasilca, D.; Iliescu-Cremeneanu, A., Photogrammetric Methods for Digital Height Models, International Multidisciplinary Scientific GeoConference: SGEM 18 (2.3), 519-526, 2018*
5. *Brebu, F.M.; Bălă, A.C., Monitoring of the special constructions in connection with the requirements of the sustenable development, Research Journal of Agricultural Science 43 (3), pp. 269-274, 2011;*
6. *Grecea, C.; Herban, S.; Vilceanu, C.B.,WebGIS solution for urban planning strategies, Procedia engineering, vol. 161, pp. 1625-1630, 2016*
7. *Roşu, D.; Machedon, G.; Tomescu, T., Aspecte privind infrastructura aeroportuară şi heliportuară, Buletinul Agir nr. 1, 2014*
8. *Reglementarea aeronautică civilă română privind stabilirea zonelor cu servituţi aeronautice civile şi a condiţiilor de avizare a documentaţiilor tehnice aferente obiectivelor din aceste zone sau din alte zone în care pot constitui obstacole pentru navigaţia aeriană şi/sau pot afecta siguranţa zborului pe teritoriul şi în spaţiul aerian al României RACR-ZSAC, ediţia 1/2015, din 09.06.2015*
9. *https://ro.wikipedia.org/wiki/Organiza%C8%9Bia_Interna%C8%9Bional%C4%83_a_Aviaţia%C8%9Biei_Civile*
10. *http://legislatie.just.ro/Public/DetaliiDocumentAfis/185948*
11. *https://www.aeroportcraiova.ro/wp-content/uploads/2019/07/OBSTACOLARE-caiet-de-sarcini-si-draft-contract-.pdf*